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GAS v. ELECTRICITY FOR STREET LIGHTING.

WE had hoped that the very last word had been said, as regards the comparative value of gas *v.* electricity even for street lighting purposes, and it, therefore, came as a surprise that a gentleman holding the position of Sir William Preece in the electrical world should have stated, as he is reported to have done recently, at a meeting of the Carnarvon Harbour Trust, that incandescent gas was, in his opinion, superior to electricity for street lighting, and that he always recommended public authorities to use it. The reason given for this remarkable statement is that "incandescent mantles distribute the light much better than do the electric lamps." No further explanation appears to have been given; and, as Sir William has earned the reputation of being a humorist, we can only assume that he is still endeavouring to live up to that reputation. It goes without saying that a proper distribution of light is not the only important factor in the efficient illumination of our streets. We presume that the main object of street lamps is, or should be, to illuminate the footways and carriage-ways; and this being the case, there is no doubt that the incandescent mantle is as badly designed for this purpose as it could be. This can be conclusively proved by anyone who chooses to take photometric or illuminometer tests. The greater portion of the light rays are projected from the mantle at an angle considerably above the horizontal, and of these comparatively few are caught by the reflector, the remainder being wasted. The man in the street usually judges the street lighting by the intensity of the light *at the burner*, and it may be interesting to quote from a paper read before the Royal Society by Sir William Preece in this connection in 1884:—"We do not want so much intensity of light as intensity of illumination on the surface of our streets and the pavement upon which the busy traffic of streets circulates."

A large number of tests taken with a Preece-Trotter illuminometer, of the illumination of the footway and carriage-way by flame gas, incandescent gas and incandescent electric lamps respectively, shows some curious results; it will be a surprise to many to learn that a common flame gas burner is better fitted for illuminating the surface of the road than an incandescent mantle, and that two 16-C.P. incandescent electric lamps, one on either side of a suitable reflector, or a flattened-bulb lamp with a reflecting back, give better results than either. An ordinary gas light column varies from 9 ft. to 12 ft. in height, and if such a column, fitted with incandescent gas, is fixed on the footway at a distance of, say, 12 ft. from a fairly light-coloured wall or building, it will be found that the building at a height of 15 ft. or more will be more brightly illuminated than the footway at the same distance. This can be easily

proved without the aid of a photometer by anyone who chooses to make the observation in a side street illuminated solely by incandescent gas.

A curve taken recently shows conclusively that the maximum light intensity of an incandescent mantle is at an angle of 20° to 25° above the horizontal. At the horizontal line it falls 10 per cent., at 20° to 25° below the horizontal it falls 14 per cent., and at 45° the light is only just over 50 per cent. of the maximum. Above the horizontal at an angle of 45°, there is given off 84 per cent. of the maximum, and up to this angle the reflector is quite useless. The illumination of the building frontage along the streets is most misleading, and conveys a very false idea of the value of gas lighting for the purpose for which it is intended.

Another curve shows the illumination in candle-feet at different distances from two incandescent gas lamps placed upon 12-ft. columns 40 yards apart. The minimum illumination midway between the two lamps is ·013 candle-ft. only, and we are, therefore, not surprised at the police notice which was recently reproduced in the *Tatler* :—"When dark sets in every conveyance is to carry a lighted lamp. . . By order. N.B.—Dark sets in when the street lamps are lighted"!!

A careful comparison of the gas light curves referred to above, with two similar curves of the light from "Excello" flame arc lamps, shows the superiority of the latter for street lighting purposes. Practically the whole of the light is emitted below the horizontal, the maximum being at 40° below, and therefore almost the whole of the light is usefully employed, instead of the greater part being wasted.

The illumination curve along the footway and carriage-way has been taken between two columns 25 ft. high and 100 yds. apart. At a distance of 16 yds. from the columns the illumination is ·5 candle-foot; at 30 yds. it is ·14, and the minimum illumination midway between the columns is ·05, or four times that of the incandescent gas. It would, therefore, be necessary to fix 5 mantles along every 100 yds. of street in order to obtain the same *minimum* illumination on the footway and carriage-way, and if the same mean illumination were required, the number would have to be considerably increased.

If it is suggested that the cost may be reduced by following the lead of electric lighting, and erecting high columns with powerful gas lamps at intervals of 100 yds., the position becomes absurd, for the following reason: An "Excello" 12-ampere lamp similar to those referred to above gives at an angle of 40° an actual candle-power of 3,000 to 3,500, and as this angle is nearly the worst in the case of incandescent gas, the mantle would have to produce *at its best angle* (20° to 25° above the horizontal) something like 6,000 or 7,000 candle-power! The whole of this would be wasted!

THE BRIGHTON TELEPHONE SALE.

The Brighton municipality has quickly followed the lead of Glasgow in selling to the Postmaster-General the telephone system established a few years ago. The total capital expenditure to the end of March last was £52,718, and the purchase price agreed on is £49,000. The Postmaster-General originally offered £41,200, that offer being based on an expert valuation of the plant. But municipal telephony is not concerned with values or practical business questions, and the Brighton M.P.'s being brought into play, the Postmaster-General was induced to raise his offer by £7,800, which lets off the Brighton Corporation with a relatively small loss in actual cash.

Like that of Glasgow, the Corporation of Brighton has been severely beaten in the competition, the National Telephone Co.'s system having considerably more than double the number of telephone stations served by the municipal system. For some time past the latter system has been at a standstill, and lately its small circle of customers has begun to diminish. In the face of such a complete business failure there was nothing left for the Corporation to do but to sell out to a benevolent Government. It is instructive to compare the actual results of the Brighton municipal system with the plans and estimates on which the business was founded. The estimate provided for 2,080 subscribers' and public station lines at a total cost, allowing for 600 partially-completed spare lines, of £43,280. The actual capital expenditure is, as noted above, £52,718, and the system actually contains 1,514 subscribers' and public lines. According to the estimate the present system, including all extension stations and other extras and allowing for 600 spares, should have been built for about £37,000. In proportion to business done the estimate has been exceeded by £15,000, or 40 per cent. In these circumstances, and in view of the fact that after three years' hard work it has not succeeded in getting more than three-quarters of the estimated number of subscribers, the Municipal Telephone Committee is to be excused for wanting to sell the business as quickly as possible.

A brief examination of the accounts published by the Brighton Telephone Committee at the time the resolution to sell was brought forward, shows the usual anomalies and the usual suggestive contrast between revenue and capital expenditure. The gross income for the year is shown to be £9,421, but of this nearly £4,000, or over 42 per cent., is overdue from subscribers. The working expenditure for the year is put at £5,780, but the capital expenditure for the year is entered as £7,395, although only 186 actual lines were added to the system during the year, and the majority of these should have been served by plant already in existence. The large capital expenditure for the year, compared with the small addition in working stations and compared with the very low working expenses, is calculated to throw a doubt on the correctness of the method of book-keeping followed by the municipal telephone concerns. This doubt is increased when some of the items of capital expenditure are analysed. It appears that during 1905-6 the average cost per mile of overhead metallic circuit was £28 11s., whereas up to the end of 1904-5 the average cost was only £25 14s. During 1905-6, 231 instruments were added at an average cost per instrument of £6 15s., whereas the average cost per instrument up to the end of 1904-5 was only £3 9s., or a little more than half. During 1905-6, £2,461 was charged to underground construction, but the only addition to the underground plant which appears in the statistics is 12 miles of metallic circuit. Presumably the money was spent on ducts not occupied by cables or on work which should have been

charged to reconstruction or repairs. In any case the cost of the work done in 1905-6, as shown by the capital account, points very strongly to the suggestion that the charges against revenue have been lightened at the expense of the capital account.

The Royal Commission on Motor-Cars.

The Report of the Royal Commission on Motor-Cars was not out in time to influence our remarks on the subject of motor-'buses the week before last, and since it has been available, we have not discovered anything which we need not have said, or much more to add.

The most interesting new fact, perhaps, is that the Commission proposes to supersede the present system of licensing, by taxation graduated according to the weight of cars, trading cars—including traction engines—to be taxed at half rate. Even the owners of motor-cars must feel, although they may not express their feelings openly, that they get off very easily under the present law, and we hope that some scheme of taxation will be incorporated in the amending Act; something very like the scale suggested by the Commission would not be amiss.

The idea is to create a central authority for allocating the proceeds of the tax to local authorities according to their needs, the whole amount being used for improving the roads, and sadly they need it in most parts of the country.

Although the speed limit of 20 miles an hour for the lighter cars has been consigned by the Commission to its proper place, motor-'buses are to be held down to the 12-mile limit in force under the existing Act. Possibly as things are just now 12 miles is fast enough as a maximum speed for 'buses, but we do not appreciate the reasons which led the Commissioners to condemn a limit of any kind (except under special circumstances mentioned in the report) for pleasure cars, while a few sentences later they "do not see any adequate reason for extending the present limit" for 'buses, especially as they use the argument in the first case that in large towns "the traffic makes great speed impossible," and no special limit is, therefore, necessary. That argument applies with equal cogency to the motor-'bus. We do not want to see motor-'buses, of the present types at least, running more than 12 miles per hour in London streets, but the case is altered entirely when the open road is reached, as it is now, by several lines and by 'buses chartered privately, and as it will be far more often in future. Most of the 'buses in use now are quite safe at speeds over the limit when driven carefully, and there can be no doubt that every month would see improvements introduced which finally would make every 'bus running on comparatively clear and easy roads at 20 or 30 miles per hour nearly as safe as a Bath chair, if only the retention of an arbitrary speed limit did not have the effect of checking invention and progress in that direction. If, on the other hand, as little attention is paid to the 12-mile limit as the pleasure cars have paid to the 20-mile limit, that will be another proof that a limit of any arbitrary kind is absurd.

We can well imagine a type of single deck, broad gauge and long base 'bus which might be evolved for express trips between London and Brighton or anywhere else. Such cars might be able to run at 30 miles per hour on the open road with the least amount of danger to anyone, yet so long as the limit is retained in the Act that ought not to be done, and we may be quite sure that if it does find a place in the expected Act, it will not be expelled for several years after everyone is convinced that it is a nuisance. We trust, therefore, that it will not be included, but that reliance will be placed on the police to check driving to the public danger equally with 'buses as with pleasure cars.

Except for the imposition of taxes and the retention of the speed limit, there is nothing in the proposals of the Commission that need alarm investors who have money in any motor-'bus concern which can weather the storm that is now being raised, about noise, vibration and smell.

THE BRITISH ASSOCIATION MEETING AT YORK.

On Wednesday the 1906 York meeting of the British Association came to an end. This is the third time the Association has met in the city where it was born 75 years ago. The jubilee meeting was held there 25 years ago, since which date electrical science and engineering have made such enormous development. With the presidential address of Prof. Ray Lankester, and with the address delivered in Section A by Principal E. H. Griffiths, we deal briefly in the following pages, but it is in the proceedings of the "Engineering Section" (G) that our readers are more particularly interested.

The Section is to be congratulated this year upon several things; first, it has seldom in recent years had so excellent a chairman as Dr. J. A. Ewing, LL.D., F.R.S., M.Inst.C.E. The fascinatingly interesting address with which he opened the proceedings stands by itself, and no previous address can be mentioned by way of comparison with it. It was devoted to considering in certain aspects the inner structure of metals, and the manner in which they yield under strain, and by experimental demonstration and lantern slides, together with the display of a fine humour, Dr. Ewing "held" everybody present from beginning to end of his discourse. A second reason for congratulation is akin to that already mentioned, for we believe the presence of so distinguished an engineer at the head of the Section had a great deal to do with the better attendance at the meetings, and, too, with the excellence—we speak generally—of the papers read.

Although the aggregate attendance at the Association meetings this year has been lower than in a good many other years, the Engineering Section has been better attended than has been customary. An audience of 70 or 80 was not at all unusual, and it was only after a whole morning had been spent in a darkened stuffy room, or when it was necessary to hurry away to keep excursion appointments, that the attendance fell to that small sprinkling of hearers which is so discouraging to the author whose fate it is to have to read his paper at that particular moment. The programme of the Section was a very full one so far as papers are concerned, and there were also excursions to the Harrogate Corporation waterworks and the Cargo Fleet Ironworks at Middlesbrough. On Saturday the Section did not meet because of the Harrogate visit, and this fact, and the special interest taken in some of the papers, made it necessary for the Section to meet on Wednesday to work off arrears which had accumulated.

Some of the papers and discussions are given in the following pages, and others that are of electrical interest will be published later.

Sir William Preece's paper, on "Glow Lamps Up-to-Date and the Grading of Voltages," created the principal electrical discussion in the Section, among the speakers being Prof. Silvanus P. Thompson, Col. Crompton, Mr. Robert Hammond and Mr. Leon Gaster.

Other papers which were followed with considerable interest were those of Mr. C. F. Jenkin, on "The Advent of Single-phase Electric Traction on Railways"; Mr. G. Gerald Stoney, on "Some Recent Developments of the Steam Turbine"; the experiments illustrating the balancing of engines, shown and described by Prof. W. E. Dalby; and the paper on "Standardisation in British Engineering Practice," by Sir J. Wolfe Barry.

It has been resolved to hold next year's meeting of the Association at Leicester, with Sir David Gill, Astronomer-Royal of Cape Colony, as President. Apparently a new rule has been started for holding the meetings earlier than has generally been the case, for next year July 31st is to be the opening day. In the following year Dublin will be the rendezvous, while in 1909 it is intended again to visit Canada, an invitation from Winnipeg having been accepted, though not without a small opposition in the meeting of the General Committee.

D

The Presidential Address.

Continual increase in the number of learned and technical societies involves every year more presidential addresses, summaries of recent advance, now in general science, now in special lines of research, now in special groups of application. These compositions are curious features of a somewhat self-conscious and hyper-sensitive age, always taking stock of its achievements and trying to foresee its further progress. Among them, the annual presidential address to the British Association has rather a special place, owed to the distinguished character of the speakers and the great diversity of scientific interests represented by their audiences. Some years ago it was thought that the British Association had done its best work, and that its place would be taken by the numerous separate technical societies that have come into existence since its foundation 75 years ago. Now there seems to be no ground for such anticipations. The number and distinction of its active members, and of its reports and transactions, are as great or greater than ever.

Prof. Ray Lankester's address, delivered at York last Wednesday, will take an honourable place in the series of these discourses. He touched many subjects, but on three he dwelt at greater length than on the others. Two of these—pathology, or the study of disease, and the recent history of the Darwinian views of the origin of species—belong to his special studies, and we look for luminous exposition thereon. But the third—radium—though lying outside his own subject, has so excited his imagination that his account can only be described as an outpouring of enthusiastic delight. For us all radium is the latest fairy story of science, and the Professor tells it like a fairy story as it should be told. But referring to the structure of the atom—

> I cannot venture as an expositor into this field. It belongs to that wonderful group of men, the modern physicists, who, with an almost weird power of visual imagination, combine the great instrument of exact statement and mental manipulation, called mathematics, and possess an ingenuity and delicacy in appropriate experiment which must fill all who even partially follow their triumphant handling of nature with reverence and admiration.

Fine thinking and fine style. Those who are not physicists may well read Ray Lankester on radium for their instruction, and everyone for his edification.

A question, which at one time would have been described, we suppose, as that of the difference between instinct and reason, between the powers inherited from ancestors and those developed by the individual animal to meet his own needs, was discussed. On this the President holds very clear and pronounced views, and he referred to a contribution by himself to the Jubilee volume of the Société de Biologie of Paris, in 1899.

> I there discussed the significance of the great increase in the size of the cerebral hemispheres in recent, as compared with Eocene Mammals, and in Man, as compared with Apes, and came to the conclusion that "the power of building up appropriate cerebral mechanism in response to individual experience," or what may be called "educability," is the quality which characterises the larger cerebrum, and is that which has led to its selection, survival and further increase in volume. The bearing of this conception upon questions of fundamental importance in what has been called genetic psychology is sketched as follows:—
>
> "The character which we describe as 'educability' can be transmitted; it is a congenital character. But the *results* of education can *not* be transmitted. In each generation they have to be acquired afresh. With increased 'educability' they are more readily acquired and a larger variety of them. On the other hand, the nerve-mechanisms of instinct are transmitted, and owe their inferiority as compared with the results of education to the very fact that they are *not* acquired by the individual in relation to his particular needs, but have arisen by selection of congenital variation in a long series of preceding generations."
>
> "To a large extent the two series of brain-mechanisms, the 'instinctive' and the 'individually acquired,' are in opposition to one another. Congenital brain-mechanisms may prevent the education of the brain and the development of new mechanisms specially fitted to the special conditions of life. To the educable animal the less there is of specialised mechanism transmitted by heredity, the better. The loss of instinct is what permits and necessitates the education of the receptive brain."
>
> "We are thus led to the view that it is hardly possible for a theory to be further from the truth than that expressed by George H. Lewes and adopted by George Romanes, namely, that instincts are due to 'lapsed' intelligence. The fact is that there is no community between the mechanisms of instinct and the mechanisms of intelligence, and that the latter are later in the history of the development of the brain than the former, and can only develop in proportion as the former become feeble and defective."

Here is a very plain issue very clearly set out. The man of the future is to inherit no instincts, no prejudices, no habits, no idiosyncrasies, or none but such as are immediately useful or necessary. As a working hypothesis to suggest experiments, and to be proved or disproved, one could wish for nothing better.

A long passage of the address dealt with the difficult controversies on the Darwinian theory carried on by Romanes, Weissmann and others, and the attempt to revive Lamarck's theory of the ability of a species to acquire new characters developed directly to meet new conditions. The questions are too intricate to be stated concisely, and the difficulty of statement explains no doubt the length of controversy, but Prof. Ray Lankester has no doubt about the conclusion to be reached.

> In looking back over 25 years it seems to me that we must say that the conclusions of Darwin as to the origin of species by the survival of selected races in the struggle for existence are more firmly established than ever. And this because there have been many attempts to gravely tamper with essential parts of the fabric as he left it, and even to substitute conceptions for those which he endeavoured to establish, at variance with his conclusions. These attempts must, I think, be considered as having failed.

Lamarck's view he believes to be vitiated by the inherent logical fallacy that his "first law assumes that a past history of indefinite duration is powerless to create a bias by which the present can be controlled, while the second assumes that the brief history of the present can readily raise a bias to control the future." The first law referred to is the tendency of the individual to maintain its qualities so long as its environment is unchanged, the second its capacity to change its qualities to meet its environment, and to transmit the change.

The most generally interesting part of the address was the account of the work of Metschnikoff and his followers, who within the last 25 years have discovered and established the true function of the white blood corpuscles or phagocytes. These active cells, similar to amoebæ, occur in all forms of life, and in all have the power of taking into their substance any minute particles, and of secreting liquids capable of digesting them. In a transparent water flea, Metschnikoff saw these floating blood corpuscles swallowing and digesting the spores of a parasitic fungus which had attacked the water fleas and was causing their death. So the function of the phagocytes is to absorb and digest any foreign matter introduced into the blood, and recovery from injury depends upon whether the phagocytes or the enemy are the stronger. The secretion and exudation of the digestive liquids by the phagocytes, the training of the phagocytes by gradually dosing them with weak infusions of the poison they are to combat, as in inoculation, strengthening them for their work by infusions of blood serum during surgical operations, are all referred to or described. Metschnikoff's work gave the explanation of the meaning of Laveran's discovery of the organism of malaria, of Ross's discovery of the action of *anopheles*, of Bruce's of the action of the tsetse fly in conveying *trypanosoma* from wild animals to domestic. To the physicist all this is as like a fairy tale as the history of radium is to the biologist.

We have given so much space to the scientific matter of this beautiful address that we can only just refer to the political part. A long passage that concludes the whole is a somewhat bitter protest against the neglect of science by the machine of Government. But it is not the Government that is at fault; it is the general body of public opinion, which does not yet understand the question at issue.

The Presidential Address to Section A.

It must be difficult for any science to keep up to the level of such discoveries as wireless telegraphy, electrons and radio-activity. Since the date of these great advances there

has been a dull time in physics, though, no doubt, a great deal of unobtrusive painstaking work is being done which, in time, will result in another series of at present unsuspected additions to our knowledge.

Under the circumstances, it was difficult for Principal Griffiths to give anything of a sensational character to his presidential address, though he dealt with many questions deserving the attention of physicists.

He drew attention to the important principle which applies not only to physics, but to all sciences, that our advance in scientific knowledge is a function of accurate measurement. The physicist has less reason to blame himself for neglecting this important principle than most scientists. For example, the mechanical equivalent of heat has now been ascertained with an accuracy of about one part in 2,000.

Dr. Griffiths pointed out one of the results of the great increase of knowledge that has taken place recently in most sciences, as revealed by the answers of students in examination papers. The candidates frequently exhibit considerable knowledge of the most recent scientific developments, but show a lamentable ignorance of the simpler phenomena and the principles they illustrate. We should think that the remedy for this sort of thing lies in the hands of the examiners.

Dr. Griffiths thinks that a marked characteristic of the progress of science in recent times is the increased public appreciation of the importance of original investigation and research. He has found this among committees of local authorities and among working men. He advocates the sending out of scientific missionaries to preach the gospel of science to every creature who is likely to be influenced by its teaching. If the elector can thus be converted, no doubt the Government will be as willing to take a scientific mandate, as a mandate on Education or Trade Disputes.

The interesting question of the acceleration in the rate of advance of natural knowledge was discussed. Is it due to the fact that a superman is being evolved with increased intellectual power? Dr. Griffiths thinks not. His explanation is that the range of our senses has been enormously increased by the invention of scientific instruments. The microscope, the telescope, the bolometer, the coherer, the electroscope have enabled us to perceive many things that were beyond the range of our unaided senses. He considers it doubtful whether a Maxwell was superior to an Archimedes. Such speculations appear to be somewhat futile.

The Evolution of the Elements.

An important discussion on the evolution of the elements took place in Section A of the British Association on Friday last. The discussion was opened by Mr. Soddy. He traced the history of the modern theory of the disintegration of the heavier atoms of matter into lighter atoms—as, for example, of radium into helium. He pointed out that Clerk Maxwell, whose prescience in so many things has been found to be correct, erred for once by declaring that no evolution of matter was possible.

It was J. J. Thomson's great discovery that the stream of cathode rays consisted of corpuscles or electrons representing particles smaller than the smallest known atom which first started the investigations that led to the belief that atoms were not really indivisible bodies. This led to Rutherford's theory of the disintegration of the radium atom. The final proof was given when Sir W. Ramsay, by exposing radium for three days in a closed tube, got enough helium to be detected by the spectroscope.

Mr. Soddy proposed that the term atom should be applied to the new indivisible, and that the old atom should be called a simple molecule, but this suggestion was not well received by the chemists. The latter, as represented by Prof. Tilden, are now reconciled to the breaking up of their ancient elements, but say that, for their purposes, the old ideas are good enough.

Mr. Soddy pointed out certain peculiarities about the breaking up of the atoms. The transformation (1) may take millions of years; (2) it is independent of the environment; (3) it proceeds from the complex to the simple; (4) enormous quantities of energy are produced.

The fact that the internal energy of the atom is enormously greater than the external energy produced by any combination of atoms explains why the environment has no effect on radio-active processes. If the internal energy of radium, for example, were given out in the same time as that of an explosive, the force developed would be a million times greater than that of the strongest known explosive.

An interesting proposition put forward by Mr. Soddy was that atoms may disintegrate without being radio-active. Rutherford, it appears, has discovered that the α-rays must have a velocity exceeding 10,000 miles per second before they will act on the photographic plate or ionise a gas. The α particles of radium, fortunately, have double this velocity, and are easily detected, but it is quite possible that many atoms in disintegrating may give off α-rays with a velocity of less than 10,000 miles per second. In that case there is no known means for proving that they are radio-active.

It was pointed out that all radio-active substances must be rare, as they are continually disintegrating and being transmuted into other elements. Radium is transmuted in 2,000 years.

A great deal was said in the discussion about the disintegration of atoms, but very little about their building up, and yet there must have been some process of this kind at one time or another, as we cannot imagine that the original radio-active atom existed from all eternity. The enormous pressures that exist in the interior of the earth are suggested as a probable cause of the formation of radio-active atoms, and if so, high pressures ought to have some influence on the rate of radio-activity. Prof. Schuster described some experiments that he had made in this direction. He exposed radium to a pressure of 2,000 atmospheres, but no change in the rate of decay was observed. He also exposed radium to a temperature of 1,000° in his laboratory; in this case a slight change in the rate of decay was observed.

Mr. Strutt considered that radio-activity that could not be detected by the ordinary test might be detected by the heat of self-bombardment. It is well known that radium remains permanently at a temperature higher than that of its surroundings. If gold, silver, iron, &c., are really radio-active they should exhibit the same peculiarity.

It was suggested by Mr. Soddy that in the X-ray tube, we had conditions where a radio-active transformation might be influenced by external energy, a large supply of electrical energy being concentrated on a small quantity of matter. In connection with this, some experiments made by J. J. Thomson were mentioned. As much as 10 c. cm. of air was fed into an X-ray tube during a period of three weeks, and this apparently disappeared completely from the inside of the tube. The tube, however, when weighed after the experiment, was found to be increased in weight by the amount of the weight of the air added. But no new element was discovered when the walls of the tube were examined spectroscopically.

Some experiments were described which showed that argon as well as helium was a disintegration product of radium.

Mr. Richardson was of the opinion that the instability which leads to radio-activity might be artificially produced, and cited some experiments made by Lenard at Kiel, which appeared to show that ultra-violet light had this effect. Experiments made at Cambridge showed that the same amount of X-rays absorbed gave off different amounts of heat with different substances. This appeared to show that X-rays might be capable of pulling the trigger of radio-activity in the case of certain substances. He considered that the cost of the energy required to transmute lead into gold would be greater than the difference between the prices of lead and gold. There was therefore no encouragement to the modern alchemist to engage in this industry.

Prof. Tilden considered that the small percentage of argon in the atmosphere lent no support to the belief in the existence of imperceptible radio-activity.

The discussion was maintained at a very high level throughout by speakers who were evidently masters of their subject.

Standardisation in British Engineering Practice.

By Sir John Wolfe Barry, K.C.B., F.R.S., &c.

(*Abstract of paper read before Section G, August 3rd*, 1906.)

In treating the subject of standardisation in engineering practice, a place of honour must be accorded to Sir Joseph Whitworth who was mainly instrumental in bringing home to the engineering world the advantages to be gained by standardisation.

The department in which his work took practical shape was in connection with the series of screw-threads introduced by him, which have now come to be regarded as the standard threads almost universally.

It had long been felt that a great waste of time and money was occurring in the rolling mills throughout the country by the use of an unnecessary number of varying sizes and shapes of angles, channels, tees, bars, rails, &c.

Inquiries among engineers and manufacturers of steel convinced me that there was a great preponderance of opinion that it was high time that in the interests of the nation, as also of the manufacturers, an effort should be made to simplify and economise the cost of production, and I was gradually led to suggest in January, 1901, to the Council of the Institution of Civil Engineers that a committee be appointed to consider forthwith the advisability of standardising in the first instance various kinds of iron and steel sections. My motion was carried, and it was decided to recommend that the Council of the Institution of Civil Engineers should approach the Councils of the Institution of Mechanical Engineers, the Institution of Naval Architects, and the Iron and Steel Institute, inviting them to nominate members on the Committee. This invitation was accepted, and the Committee thus constituted met for the first time in April, 1901. Mr. Leslie Robertson was appointed as secretary, and to his indefatigable exertions the movement is very greatly indebted. At a later date the Institution of Electrical Engineers was invited to co-operate with the other four institutions, which invitation they accepted. Thus constituted, and supported by the five leading technical institutions, the Engineering Standards Committee has gradually grown from one committee with seven original members till at present it numbers 36 committees with about 260 members, and the number of subjects dealt with has increased to no less than 30, entailing the preparation of about 75 different specifications and reports.

In the initial stages the funds necessary for carrying on the work were supplied entirely by the supporting institutions; but it was recognised at an early date that the support and countenance of his Majesty's Government would be invaluable to the movement, and also that the various Government departments, who were large users of the materials for which standards were being drawn up, should be asked to support the Committee by nominating representatives to assist in their deliberations and by the adoption of the Committee's standards when issued. With this object the Committee approached his Majesty's Government, and an interview was held with Mr. Balfour, who intimated that the financial support sought by the Committee would be forthcoming, that the findings of the Committee would, as far as possible, be adopted for use in the Government departments, and that they should be further supported by the appointment on the various committees of engineer officers representing different Government departments.

As far as possible the committees have been so constituted as to embrace among their number representatives of all interests involved. It has thus been practically ensured that those serving on the Committee can speak with full knowledge and authority on the subjects dealt with.

Carefully-prepared lists of questions for circulation to users and manufacturers throughout the country have been issued, and the replies to these questions have been collated, and on the results of these inquiries the Committee's decisions are largely based.

It was felt from the first that a most important point in any proper scheme of standardisation was to avoid the danger either of crippling invention or perpetuating forms or processes which in course of time might become obsolete.

To carry out this view the Main and Sectional Committees continue in existence after their reports have been made, and an opportunity is afforded once a year to the Sectional Committees of revising the specifications issued by them, so as to ensure that the standard specifications are kept thoroughly apace with the progress made from time to time in engineering science.

Standardisation may roughly be divided into two classes—that dealing with shape and form, and that dealing with material. In regard to shape and form, the guiding principle of the Committee has been to place at the disposal of the engineer such shapes and sizes as may reasonably be needed by him to meet the general requirements of every-day work, and they have carefully avoided indicating to the engineer how and when these shapes should be used, or what particular strains should be allowed in the material composing them. The Committee have felt that this is a question entirely for the engineer, and that he alone must decide what stresses may be allowed in the structures which he is engaged in designing.

When the Committee commenced their labours it was not their intention to deal with the standardisation of material, but it soon became evident that assistance of a very real character could be rendered to the manufacturers of this country if high-class standard specifications were issued, covering the materials more generally used in engineering.

The multiplication of various specifications differing from one another often in unimportant details, but yet sufficiently divergent to preclude the unification of the process of manufacture, was a widely experienced difficulty, and one which the Committee sought, by the issue of standard specifications, to remove. It was felt that if a high-class standard specification were generally acknowledged, it would inevitably have the tendency of improving manufacture and assisting British contractors to meet competition.

The advantages accruing from the work accomplished are now so familiar that we hardly realise their extent, and may be tempted to minimise their value.

As a practical illustration, the testimony of a large steel maker in Scotland may be cited, who admits that, since the introduction of standard sizes, his firm has been able to break up some hundreds of tons of rolls, and by no means the least advantage gained is that in his works the process of manufacture is now no longer so constantly interrupted as it used to be, due to the frequent changing of the rolls to produce in smaller quantities the many special sizes asked for, without any corresponding advantage to the consumer.

A further striking illustration of the advantages of standardisation occurred in connection with the construction of the tramways of a large Midland city. An order for the rails (to be made in conformity with the British standard specification) was, in the first instance, placed with a Continental firm. From want of expedition and punctuality in making deliveries, and from failure to comply with the stipulated tests, &c., the Corporation and their contractors were placed in a position of considerable difficulty by the contructional work being brought to a standstill. This caused them to approach a British firm, who, having the "standard" rolls already cut, undertook to make a delivery within a few days, with the result that the Continental order was cancelled and transferred to the British firm.

Altogether orders have already been received for nearly 100,000 tons of these standard rails, probably representing a value of over half a million of money. Practically all the British firms of tramway rail makers are now equipped with sets of rolls for the standard sections, and they are thus enabled to deliver such rails at very short notice, instead of the general experience heretofore of having to spend several weeks in the preparation of new rolls. This is not only a great advantage to the purchaser, but also a considerable saving in expenditure to the maker, as the cutting of a set of rolls usually costs about £200.

Apart from its general influence on the expansion of trade, it is estimated that there will be a saving of some millions sterling to British manufacturers in reduction of cost of production by the standardisation of iron and steel sections alone.

With a view of introducing standardisation in its most efficient and stable form the Committee have decided to establish at the National Physical Laboratory at Bushey a series of gauges and templates to which all the templates throughout the country can be referred, and from time to time checked. All these standards are made with the greatest possible accuracy, and are most carefully verified by measuring-instruments at the Laboratory before acceptance. It is confidently hoped that by establishing a mechanical high court of appeal, unification and accuracy may be promoted throughout the country.

Considering the short time which has elapsed since the issue of the first Standard Sections and Specification, the success of the movement has been most marked and beneficial. It may be confidently predicted that the future effect of the movement will be greatly to the benefit of the nation.

Discussion.

The Chairman (Dr. Ewing) said it must be a particular satisfaction to Sir J. Wolfe Barry to be able to give that record of such a remarkable piece of work accomplished at his initiative. Would he tell them shortly what his views were about this:—The tendency which British standardisation must always have to keep us out of line with other countries in the matter of practical units?

Sir William Preece supported all that the author had said. One point he had not dwelt upon. He was talking about standardisation with one of the largest manufacturers of electrical plant and the benefit of standardisation to the public, when the said manufacturer supported him by saying that there was nothing in the whole of the engineering world so outrageous as the want of uniformity and standardisation in electrical motors which were now coming into use with such phenomenal speed. He pointed out that they could not stock any type of motor because the electrical engineering people of this country seemed for the past few years to have been striving to show how impossible it was to establish standardisation among the electrical plant and the installations in this country. They had 472 large installations at work; they had nearly 1,000,000 h.p. at work. Of the 472 installations nearly 400 were in a state of hopeless confusion. One great result of this movement would be to establish standardisation enabling manufacturers to stock electrical plant, and the public would reap the benefit by getting a considerable reduction in the cost.

Prof. Dalby cited a case where standardisation would have been advantageous. It occurred between the North-Western Railway, and the department to which the Chairman (Dr. Ewing) belonged. The rails on a pier used by the N.W. Railway had to be relaid. The order went to Crewe, but the work was to be done with rails of the same section that had been used in the first instance. No manufacturer had that particular Admiralty section, but the Admiralty insisted upon having it. The effect was that they had to make new rolls completely to make these few rails.

The Chairman: That was before my time.

Sir W. H. White said that no doubt Prof. Dalby's story was quite correct. He said it was many years ago. Even that department had since taken an active interest in the work of standardisation. Sir William dwelt on the enormous advantage of the appointment of this committee by bringing both maker and designer into con-

ference. In regard to Sir Wm. Preece's instance (electrical machinery), that brought out the point that it only became possible to standardise at a certain stage of development. They wanted to avoid stereotyping and interference with invention. In a new industry such as Sir W. Preece had mentioned, it was inevitable that there should be freaks and competing schemes and so on up to a certain point—standardisation came on later. The effect of standardisation could only be beneficial when the methods and limits were fixed by those who understood what was required. He had seen standardisation carried to an extent which was ridiculous, when those who had the power of saying the last word had not the necessary knowledge. Looking to the future, what they had to realise was that the back had been broken of an enormous amount of initial labour. They saw daylight through what at first was a great mass of material that had had to be dealt with.

Mr. C. F. Jenkin said that one of the causes that had made standardisation more difficult here than abroad was the employment of the consulting engineer between consumer and producer. In Germany that was not the case. In England it had been almost impossible to get these three to agree.

Mr. Hawksley said with reference to the chairman's remarks, the Standardising Committee of which he was chairman took care before arriving at standards in this country for cast-iron pipes, to ascertain what was being done on the Continent, so that advantage might be taken of whatever appeared to be good—both on the Continent and in America. He agreed with what had fallen from Sir Wm. White with regard to the standardisation of a new industry. He thought with him it would only cripple development of a new industry to attempt to standardise it before it had settled down to at least a certain limited number of accepted designs. It was most essential to avoid by standardisation anything like the crippling of design.

A Speaker cited an instance showing the need for standardisation being adopted by the engineering department of the Navy.

Sir J. Wolfe Barry admitted that standardisation could be carried too far, and it would be quite wrong to attempt to standardise new inventions, but although there were two very pronounced sides to the matter when they began, one side had now dwindled into obscurity. The whole weight of engineering opinion had now been thrown definitely on the side of standardisation of those things which could be properly standardised. They had provided for elasticity of design and invention. They had felt from the first that this was even more important than standardisation. The result to engineers and manufacturers in coming together had been beneficial to both, and they had been able to arrive at results which were beneficial to both maker and user. They might congratulate the country on being in the van of this improvement, which was, he thought, of the greatest possible importance to the maintenance of our commercial position in all the markets of the world.

Several of the speakers in the course of the discussion paid a tribute to the excellent service rendered by the secretary of the Standardising Committee, Mr. Leslie Robertson.

A Magnetic Indicator of Temperature for Hardening Steel.

By William Taylor.

(Abstract of Paper read on August 3rd before Section G.)

The well-known troubles of warping and change of size when hardening tool steel experienced in the case of some specially exacting work, led me to seek some more reliable and convenient indicator of hardening temperature than those in common use. Dissatisfied with the results obtained by the use in an ordinary workshop of an electrical pyrometer employing a thermo junction, with the inconvenience of having to obtain a cooling curve with each sample of steel, and the uncertainty arising from the need of heating the object above the critical point so obtained to meet the fact that the critical point for heating is higher than that for cooling, I sought to make use of the known fact that at this critical point the magnetic permeability of the steel is changed. With the co-operation of Mr. F. J. Mudford, I experimented with a magnetic induction balance consisting of three similar flat coils of wire placed parallel on a common axis and equally spaced, the inner coil in circuit with a telephone receiver, and the outer coil supplied in series with an alternating current, and so connected that at ordinary times no sound was produced in the telephone. When, however steel was placed between the centre coil and either of the outer ones, the magnetic balance was disturbed and a sound produced in the telephone. The steel was then heated, and when it reached the critical temperature and became non-magnetic, the sound in the telephone abruptly ceased, whereupon the steel was quenched and hardened. Steels with carbon contents ranging from ·7 to 1·35 per cent. were hardened in this way at temperatures which, judged by the eye alone, no skilled mechanic would feel safe in using, while the fine grain shown on fracture, together with the invariable hardness, showed how closely the critical temperature had been obtained. In each case on letting the steel cool so that sound was resumed in the telephone, the steel failed to harden, although the fall of temperature was imperceptible to the eye. Following this experiment, the magnetic indicator (which was exhibited to the meeting) attached to a small muffle furnace, was constructed, and has been in daily use in a tool room for several months, where it has served to indicate temperatures for hardening press tools, milling cutters, taps, reamers, &c., and has established a record during that time in that not a single piece has been lost through warping or cracking in hardening, while the quality of the hardening has been excellent.

The attachment consists of a hardened steel permanent magnet, extended by soft iron pole-pieces into the general form of a horse-shoe magnet, the gap of which is in the muffle of the furnace, and is so adjustable that the piece of steel to be hardened may be arranged to fill the magnetic gap. The pole-piece at one side of the furnace is hinged, by rocking on the magnet, and is prolonged in such a way as to form a second and alternative magnetic circuit tending to displace the rocking pole-piece and withdraw it from the object being heated. This, however, so long as the object is magnetic, is prevented; but when its temperature rises to the critical point, and the steel object, becoming non-magnetic, releases the pole-piece, the latter rocks, and in so doing establishes an electrical circuit by which a bell is rung, giving audible warning to the attendant. This device has proved of great practical service by making the work of miscellaneous hardening safe and certain in its results. It is noticeable in every case that the temperature at which hardening is thus safely accomplished is visibly lower than that at which a skilled workman would ordinarily harden steel when endeavouring on the one hand to avoid over-heating, with its resulting brittleness, cracking and warping, and on the other hand, the failure to harden, and the certainty that in re-hardening these risks of cracking and warping would be multiplied.

The Removal of Dust and Smoke from Chimney Gases.

By S. H. Davies, M.Sc., and F. G. Fryer, A.M.I.M.E.

(Abstract of Paper read in Section G on August 3rd.)

In this paper the authors describe the results obtained with a specially-designed plant at Messrs. Rowntree's Works, York. The boiler plant consists of five Lancashire boilers, 30 ft. by 8 ft. and one of 30 ft. by 8 ft. 6 in., working at 100 lb. pressure, and fitted with Bennis sprinkling stokers and coal-feeding elevators. McPhail & Simpson's superheaters are fitted in the downtake of each boiler, raising the temperature of the steam to about 520° F. The economisers are of the "Green" type, and consist of 600 tubes. The temperature of the feed water averages 250° F., while that of the flue gases on leaving the economisers averages 320° F. The average consumption of fuel amounts to 310 tons per week.

It was found necessary to install a 7-ft. diameter induced draught fan two years ago to increase the evaporation on the existing boilers, while maintaining the chimney gases fairly free from smoke. It is placed at the base of the chimney, which is of brick, 6 ft. in diameter at the bottom, 5 ft. at the top and 150 ft. high. With this fan and chimney the suction on the main flue is about ¼ in. water gauge when all the boilers are in use. The addition of this fan has practically doubled the draught at the fires.

A dusty pea slack from the South Yorkshire coalfields, having an average calorific value of 12,500 B.Th.U., and containing 10 per cent. of ash, is used. Of this coal, 40 per cent. consists of dust and fine smudge, which will pass through a ⅛-in. mesh.

Since the installation of a power gas plant, less than one-third of the steam generated has been used for power, the remainder being required for boiling, heating, &c.

Owing to the special conditions, the authors could not aim at what may prove to be the ultimate solution of the problem, the non-production of either dust or smoke in the furnace, and so turned to the only alternative, that of intercepting the dust and smoke from the furnace gases. With this object in view the flues were arranged so that the gases could travel in either direction through the economisers, and a brick chamber (37 ft. long, 14 ft. 6 in. wide, and 17 ft. high) was built at the end opposite to the existing fan and chimney, in which the gases could be washed. The gases are drawn through this smoke washing chamber by an 8 ft. 6 in. fan, and delivered to a steel chimney of 7 ft. diameter, rising 50 ft. above the top of the washer. The fan is run to give about ½-in. water gauge in the main flue.

The smoke washer is lined with Staffordshire bricks set in cement; the four baffles are made of cast-iron plates. Water can be supplied in the form of coarse spray through a number of Harrison's patent spraying nozzles and, further, in the form of continuous sheets of falling water. There are also two hot and one cold water nozzles close to the inlet from the flues.

The floor of the smoke washer slopes towards the outlet, and any grit or dust deposited on it is washed down at intervals by a flush of water from three automatic tippers (T) built into the walls. After passing a water seal, the grit is collected in either of two parallel settling tanks. It is intended to deal with grit in future by draining on sieves and elevating to a truck for removal.

The gases pass from the economiser chamber at a temperature of about 320° F. and at a velocity of 20 ft. per second into the first section of the smoke washer, where the velocity is reduced to 3·7 ft. per second. It was found best to saturate the gases as far as possible with water vapour in this section, supplying a plentiful spray of hot water from the economisers through nozzles at a temperature of 250° F.; to which is added exhaust steam from the fan engine. After passing over the first baffle the gases come in contact with cold water from one or both of two sets of sprays in the second section. They impinge against wet walls and sweep down on to a floor covered with running water before passing under the second baffle. At this point, if necessary, they can be drawn through a continuous sheet of water falling from the edge of the baffle. In the third section the gases are subjected to further chilling and washing by means of cold water sprays, and, if desired, the process can be repeated in the fourth section by sprays. The gas emerging under the last baffle can be washed by another sheet of water, and passes direct into the fan suction from the last section of the chamber, which contains a single nozzle.

The authors arrived at the following conclusions:—

1. The application of steam and hot water in the first section gives much better results than the use of cold water sprays at this point.

2. The cold water is best applied in the second and third sections.

3. The application of sheets is an extravagant method of using water, and so long as the walls and floor are kept wet and the sprays are under sufficient pressure, sheets may be dispensed with.

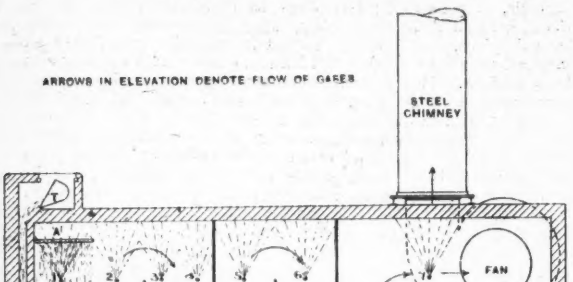


Diagram Showing Arrangement of Washing Chamber in Elevation.

4. With gases leaving the economiser at 300° to 350° F. a favourable temperature for the exit gases is 130° to 135° F., while the water running to waste has a temperature of 110° to 115° F.

5. The minimum volume of water requisite to deal with 2,400,000 cb. ft. of hot gases per hour is from 7,000 to 8,000 gallons, distributed approximately as follows:—

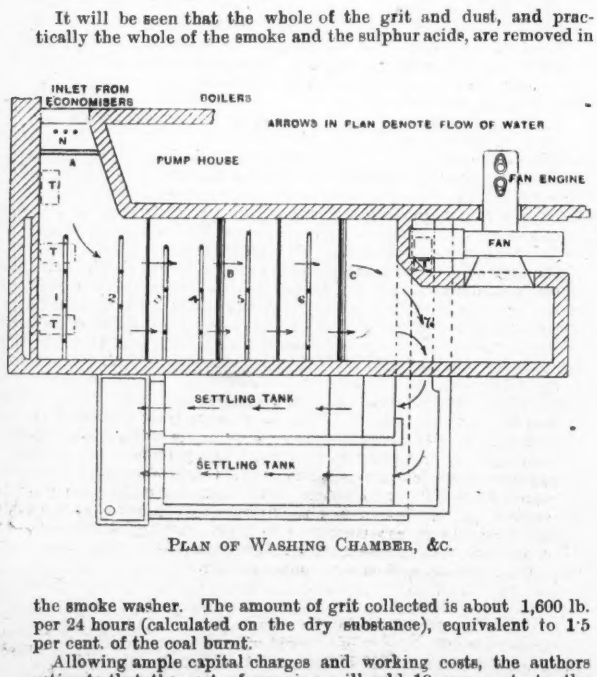
Cold water: tippers, 1,000 gals.; sprays, 5,000; hot water sprays, 1,300; exhaust steam, 100; total supplied = 7,400 gals. Deduct water vapour required to saturate exit gases at 130° F. = 1,000 gals., and the water running through settling tanks to waste = 6,400 gals. per hour.

Most of the sulphur acids present in the flue gases are dissolved in the wash water, but the gas passing to the fan is not entirely free from a slight acid spray, and it has been found advisable to inject a small quantity of dilute soda solution on to the fan blades, to neutralise continuously the sulphuric and sulphurous acids, and so protect the metal from corrosion.

A comparative series of experiments on the gases at the base of the main brick chimney and on the washed gases at the base of the steel chimney gave the following results:—

	Ordinary chimney gases containing 5·1 per cent. CO_2 (mean of 6 experiments).	Washed gases.
Total S. acids (calcd. as SO_3)	0·2	0·005 gram per cm.
Grit	0·36	Nil
Smoke scale (Ringelmann's)	2·1	Trace only.

It will be seen that the whole of the grit and dust, and practically the whole of the smoke and the sulphur acids, are removed in the smoke washer. The amount of grit collected is about 1,600 lb. per 24 hours (calculated on the dry substance), equivalent to 1·5 per cent. of the coal burnt.



Plan of Washing Chamber, &c.

Allowing ample capital charges and working costs, the authors estimate that the cost of running will add 10 per cent. to the annual cost of coal.

The authors experimented with a view to proving the efficacy of adding lime water to fuel, with a view to diminishing sulphurous acid in the gases of combustion, and came to the conclusion that within practical conditions no effect was produced.

Discussion.

Mr. Robert Hammond congratulated the authors upon their practical paper, which came at an opportune moment, for the problem of the abolition of chimneys used in connection with small factories in towns and their substitution by large generating stations was present all over the country. During the past session he had had to carefully consider the subject before a Parliamentary Committee. Any method by which they could get rid of sulphur would be a considerable help. He noted in the paper that with the combustion of 310 tons of coal per week at Rowntree's works, there was an expenditure of 6,000 gallons of water per hour. The problem he (Mr. Hammond) had to deal with was more than 20 times as large, and if water cost 1s. per 1,000 gallons, that would be £50,000 a year, a large sum to pay for the elimination of the sulphur. The demand of the Commissioner of Works for the elimination of sulphuric acid was putting upon any industry too heavy a burden when it reached such figures as that. He was pleased to note that the authors dissented from the dictum laid down by Dr. Thorpe that the matter was easily dealt with by putting a little lime water on the coal. With large undertakings one point that came out was the question of the cost of water. In Messrs. Rowntree's works they pumped water for nothing, but in large centres they would not be in that happy position. If they had to undertake such a thing at Johannesburg, they would have to pay 3s. 6d. per 1,000 gals. for the water so used.

Prof. Hele-Shaw said that the title of the paper did not limit the kind of chimney. He was informed that already in Germany serious attempts were being made to deal with the gases of ordinary chimneys. At first sight it looked like a hopeless project. It was not so, except from the point of view of expense—to collect the gases from the domestic chimney and to treat them. He ventured to think the time would come when, even in London, the air would be purified from that fearful state of fog which was caused, they believed, almost entirely from the domestic chimney smoke, and not so much from the factory. As science advanced, the millions lost by the emission of all this smoke would be seriously dealt with. He welcomed the paper as a serious attempt to tackle the question.

Mr. Hawksley and the chairman added a few words.

Recent Advances in Steam Turbines, Land and Marine.

By G. Gerald Stoney, B.E., M.I.C.E., M.I.E.E.

(Read in Section G, August 7th.)

In steam turbines used for driving alternators and dynamos for electric light and power, the advance during the last few years has been very rapid. It was only in 1884 that Mr. C. A. Parsons made his first turbo-dynamo of about 10-h.p., and in 1888 the size had increased to 350 kw.; in 1896, to 500 kw.; in 1900, to 1,250 kw.; in 1902, to 1,500 kw.; and in 1904, to 4,000 kw., while many of larger sizes, up to 6,000 kw., are now in hand under his patents. Practically the whole of the great distribution of power development on the North-East Coast, described before this Section two years ago by Mr. C. H. Merz, is now supplied from these steam turbines. They also supply the power for the electrification of the underground railways of London, and on the Continent the great Paris stations, which will eventually have some 11 plants of 5,000 kw. each, are adopting Parsons turbines. In this country the largest turbine stations are those at Neasden, Chelsea, and at Carville, near Newcastle-upon-Tyne, the latter having two turbines of 2,000 kw. and two of 4,000 kw., and four more of the larger size will shortly be added, making a total installed of 28,000 kw., with an overload capacity of about 50,000 kw. for the peak load. The supply is three-phase at 6,000 volts and 40 periods, and the 4,000-kw. turbines take 15·4 lb. of steam per kilowatt-hour, with 200 lb. boiler pressure, 150° F. superheat and 28½ in. vacuum, barometer 30 in.

For the great power scheme proposed for the supply of London, turbines of 10,000 kw. have been designed with an overload capacity of 100 per cent., and it is confidently expected that with them a consumption of 13 lb per kw.-hour will be reached. For continuous current work, several turbo-dynamos of 2,000 kw. have been made, and by the use of a compensating winding and certain improvements in the commutators and brush gear the commutation troubles which were formerly experienced in large sizes have been completely overcome.

During the last three or four years a turbine blowing engine has been developed, chiefly for use in connection with blast furnaces. This engine consists of a turbine air compressor directly coupled to a steam turbine. The air portion is built up of alternate rows of fixed and moving blades, the fixed or guide blades being secured to the turbine case and the moving blades to the revolving drum or shaft. The moving blades are set at an angle to the plane of revolution of the shaft, and each row may be compared to a multi-bladed propellor, the fixed or guide blades merely serving to direct the air in a longitudinal direction along the cylinder after it leaves each row of moving blades. The first machine of this type was installed at Messrs. Cookson's Lead Works on the Tyne, and was used for lead smelting. It was driven by a high speed electric motor at about 4,000 r.p.m., and the output was 3,000 cb. ft. of free air per minute against 1¾ lb. per sq. in. blast pressure. In practice it was found that the steady and continuous blast maintained by this

machine greatly improved the output of lead from the furnace, as compared to that obtained with the pulsating blast from the Root's blowers previously used. This same effect has been noticed in the case of iron blast furnaces. A considerable number of these turbo blowers have been built for iron smelting, the usual size delivering about 20,000 cb. ft. of free air per minute, against 10 lb. normal blast pressure when running at 3,000 r.p.m., and a special by-pass valve is fitted on the steam turbine by opening which, the speed can be raised to 3,800 r.p.m., and the output of the plant increased by 50 to 60 per cent. at a moment's notice. The blast pressure can thus be raised to 16 or 17 lb., or at lower pressures a proportionately larger volume of air can be delivered, showing the great flexibility of the plant.

Blast furnaces when blown by turbo blowers are found to be much less liable to develop "hangings" or "scaffolds," and even when they do, they are quite easily blown free by simply opening the by-pass valve. The weight of such a plant is only 25 tons, as compared with 140 tons for a reciprocating plant, a 5-ton overhead crane being large enough to deal with all lifts. As in the case of all turbine plants on land, only light foundations and no holding-down bolts are necessary.

It would be well to mention here the small consumption of oil by an engine of this size. It amounts to only half a gallon per week, representing a weekly oil bill of 1s. 9d.

When considering the efficiency of blowing engines, the most important point to know is the quantity of steam required to deliver a certain volume of air against a certain pressure. This latter may be taken as the adiabatic horse-power in the air, and if considering the overall thermal efficiency of the whole plant, the former may be taken as the available energy in the steam when worked according to Clausius' or Rankine's cycle. As a typical case, a turbo blowing engine at Messrs. Wilsons, Pease & Co.'s works, Middlesbrough, may be taken. This engine, when delivering 18,500 cb. ft. of free air per minute against 10 lb. blast pressure, was found to take 15,100 lb. of steam per hour. The turbine was supplied with saturated steam at a pressure of 150 lb. per sq. in., and exhausted into a 27 in. vacuum (barometer 30 in.). This represents a steam consumption of only 22·5 lb. per adiabatic H.P.-hour, or an overall thermal efficiency of 37·4 per cent.

Another turbo blowing engine, for the copper smelting furnaces at the Mount Lyell Mining Co.'s works in Australia, required 5,980 lb. of steam per hour when delivering 18,100 cb. ft. of free air per minute, against a pressure of 7 in. of mercury, which is equal to 255 adiabatic H.P. Steam was supplied at 140 lb. per sq. in., superheated about 70° F., the vacuum at the cylinder exhaust being 27 in. mercury, barometer 30 in. This result gives a steam consumption per adiabatic air H.P.-hour of 23·5 lb., or an overall thermal efficiency of 34·3 per cent. It will thus be seen that the turbo blowing engine compares very favourably in steam consumption with the very best modern reciprocating plant, while, at the same time, the running expenses and repair bill are much less.

A turbo blower of a slightly different type to those we have just been considering has been constructed for dealing with large volumes at low pressures. These plants are arranged so that they can either be used for blowing or exhausting, and in several large ironworks in Scotland have replaced the blowers of the revolving drum type for dealing with the waste gases from the blast furnaces, and pumping them through the recovery plant. The usual capacity is about 30,000 cb. ft. of gas per minute, and the suction or pressure about 1 lb. per sq. in. In one installation in Scotland, which has been working for nearly two years, three turbo exhausters, weighing in all 20 tons, have replaced twelve exhausters of the revolving drum type, the drums alone of which weighed together over 100 tons. In these blowers there generally are three to five cast-steel propellors with rings of spirally-shaped guide blades between them, the speed being about 7,000 to 8,000 r.p.m.

A noteworthy point in connection with these machines when dealing with blast furnace gases is that, owing to the high velocity of the gas through the machine, they do not become clogged with tar and other matter.

It is well known that it is almost, if not quite, impossible to utilise economically by a reciprocating engine low-pressure steam at about atmospheric pressure, and it is under these conditions that the exhaust steam turbine becomes of importance.

In 1894 Mr. Parsons took out a patent for the utilisation of the exhaust from a reciprocating engine by a steam turbine, and this was first put into practice in H.M. destroyer *Velox* in 1903, which had a pair of small reciprocating engines exhausting into the main turbines at cruising speeds, they being disconnected from the main turbines when it was desired to run at high speeds.

At Messrs. Guinness's brewery in Dublin, the vats are supplied with steam from the exhaust of turbines exhausting at about 11 lb. per sq. in. above the atmosphere, which, of course, is only possible as the exhaust steam of turbines is absolutely free from oil and other deleterious matter. At certain times this exhaust is more than the vats can utilise, and then, instead of wasting the steam, it is sent through an exhaust turbine of 250 KW. to a condenser. This turbine, when supplied with steam at 11 lb. per sq. in. and a vacuum of 26½ in. (barometer 30 in.) took only 34·4 lb. of steam per kilowatt-hour, giving an efficiency between British thermal units in the steam by Rankine's cycle and electrical horse-power of 57 per cent.

Another instance is at Messrs. John Brown & Co.'s at Sheffield, where the exhaust from a blowing engine will shortly be utilised in a steam turbine and expanded from about atmospheric pressure to a vacuum of 27 in. This will give an additional power of about 316 KW.

Since, as is well-known, the steam turbine, unlike the reciprocating engine, can fully utilise the highest vacua, and can exhaust right down to the vacuum of the condenser, it is most important that this vacuum should be as high as possible. As a rule the temperature of the inlet cooling water is fixed, and therefore it is important to keep the difference of temperature between the cooling water and that due to the vacuum in the condenser as small as possible. One obvious way is to increase the volume of the circulating water, but it has not been found advisable in practice to increase this above about 60 times the weight of the steam used, giving a rise of temperature of about 17° F. between the water entering and leaving the condenser. It is then the object of the designer to get the temperature due to the vacuum in the condenser as near as possible to that of the cooling water leaving the condenser, and in this regard great help is given by the use of what is called a "Vacuum Augmenter," which consists merely of a steam jet placed in a contracted pipe between the condenser and the air pump, which compresses the air and vapour from the condenser and delivers it to the air pump through a small auxiliary condenser. This device was fully described in the paper read by Mr. Parsons and myself last December before the Institution of Civil Engineers. By the help of this, with even as high rates of condensation as 11 to 14 lb. per sq. ft., the temperature due to the vacuum is not more than 4° to 6° F. above that of the water leaving the condenser, and less at smaller rates of condensation. These high vacua are impossible with air pumps of ordinary construction. Thus on the *Manxman*, a cross-channel steamer, when condensing at the rate of 14 lb. steam per sq. ft. of surface, the sea temperature being 54° F., the water leaving the condenser was 88° F., and the vacuum 28·4 in. (barometer 30 in.) representing 94° F., or a loss of only 6° F. Here it was found that the gain with and without the augmenter on was from 1 in. to 1½ in. of mercury. In land condensers when working at the rate of 11 lb. per sq. ft., the inlet water being 52·5° F., and leaving the condenser at 67° F. a vacuum of 29·25 in., with the barometer 30 in., is obtained, showing a loss of temperature of only 4° F., while at smaller loads the vacuum rose to 29·5 in.

When it is remembered that between 25 in. and 26 in., or 26 in. and 27 in. vacuum there is a gain of steam consumption at full load in a turbine of about 4 per cent., rising to 5 per cent. between 27 in. and 28 in., and about 7 per cent. between 28 in. and 29 in., or that about 2½° F. decrease of temperature represents a gain in consumption of 1 per cent., and that the proportionate increase is much greater at smaller loads, it will be seen how important it is to get as good a vacuum as possible.

As the steam consumption in the jet of the vacuum augmenter only amounts to some 1 to 1½ per cent. of that used by the turbine, it will be seen that a gain of about ¼ in. of vacuum more than counterbalances this extra steam used.

Space forbids much being said about the greatest development of the steam turbine, that for marine propulsion. It is only 12 years since the question of building the little *Turbinia* was mooted; it is only nine years since she was completed, and astonished everybody by her speed at the Jubilee Review at Spithead in 1897, and yet now out of a total number of 68 vessels on Lloyd's Register of over 20 knots, no less than 10 use Parsons turbines, and the largest steamers in the world, the great express Cunarders, *Mauritania* and *Lusitania*, which are to cross the Atlantic at 25 knots sea speed, and which will require some 70,000 I.H.P. to propel them, are being fitted with these turbines; and so rapid has been the development of the steam turbine for marine propulsion, that it has been found necessary to license over 40 of the leading engineering and ship-building firms in this and other countries, to build these turbines, and the total H.P. of marine turbines completed and on order, now approaches 1,000,000 H.P.

On the score of economy it has been found that cross-channel boats use from 15 to 25 per cent. less coal than those with reciprocating engines, besides having a smaller engine-room staff, as well as using much less oil, waste and other stores.

In the case of the third-class cruiser *Amethyst*, it was found that the turbines were superior in economy to a similar boat with the latest type of reciprocating engines from 14 knots upwards, while at full speed she attained 23·63 knots, as against 22·1 of the vessels with reciprocating engines, and used 5 per cent. less steam, the additional speed representing an extra power of 35 per cent.

All turbine boats hitherto fitted, with the exception of the *Viper* and the *Cobra*, which had four shafts, and a yacht which had two, have been with engines of the three-shaft type, with the H.P. turbine on the centre shafts, and L.P. on the wing shafts, which L.P. turbines also contain the astern turbines with the addition, in case of warships, of cruising turbines for low speeds. In very large ships four shafts are preferable, having H.P. turbines on the centre shafts and L.P. on the wing shafts, while in a small low-speed yacht two shafts have proved successful, having a H.P. port and L.P. starboard.

In the case of tramp steamers of, say, 10 knots, a very great economy will be obtained by the use of an exhaust turbine with the reciprocating engine exhausting into it. If we examine indicator diagrams of a tramp steamer, it will be seen that the steam is usefully expanded down to about 7 lb. absolute only, and that nearly the whole of the energy from 7 lb. to, say, 1 lb. absolute is wasted. By the use of exhaust turbines, the greater part of this can be recovered, representing a net gain of from 15 per cent. to 25 per cent. in the power on the same coal bill. It is expected soon to put this system into actual operation.

A brief discussion followed the reading of Mr. Stoney's paper, the speakers being Dr. Ewing, Messrs. Hammond, Attwood, Hawksley, Maccall, and Col. Crompton, to whose remarks the author replied.

(To be continued.)

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Electricity in Collieries.

Your correspondent's letter signed "Power" in your issue of 27th ult. refers to me, and I regret that owing to absence from home I cannot search through old notebooks to furnish accurate information on the different points, but from memory I can answer his questions in general terms as follows :—

1. Electricity was first used in collieries for signalling purposes, but I have no information as to the date of the first such application. In 1883 there were several lighting installations at work in collieries to my knowledge; I think that at Earnock was the first, and would be put in about 1882, but I can give no details from memory.

2. The first installation for power was, so far as I can remember, at Trafalgar Colliery for pumping, and the type of motor, in all probability, was series. Probable date, 1888.

3. I believe I put in the first three-phase plant at a British colliery about 1893 or 1894, consisting of six motors for working in-bye pumps. Pressure 500 volts, motors totally enclosed, and squirrel cage.

4. I know of no single-phase alternators now working at collieries. I put one down about 1891, 40 KW. 2,000 volts, which worked for a number of years, lighting the colliery and the owner's residence about 1½ miles away. There were also in the early days several alternators working Jablochkoff candles, but I fancy all these have been superseded.

If "Power" cares to write me direct, informing me of the purpose for which he is collecting information, I could doubtless assist his researches into ancient history.

G. Stephen Corlett.

Wigan, *July* 31*st*, 1906.

I notice in your issue of July 27th that a correspondent signing himself "Power," requires some information with reference to the early history of the application of electricity in collieries.

The following particulars may be of interest to him :—

In the year 1891, Messrs. D. Selby Bigge & Co. carried out a mining installation embodying winding, hauling and pumping at one of the Earl of Durham's collieries, which now belongs to Messrs. The Lambton Collieries, Ltd.

Considering that the use of electricity in collieries is becoming so universal, the particulars I give below of this installation, I think, cannot fail to be of interest.

A generating station was erected at the colliery, and two Willans engines running at 380 r.p.m., indicating 140 H.P. each, were installed. These were placed at each end of a line shaft, and were fitted with claw clutches. From the line shaft were driven two power dynamos of 65 KW. each, running at 500 r.p.m., shunt-wound, 780 volts, continuous current. Two dynamos for exciting and lighting at 100 volts were also driven off this shaft. The armatures were Gramme wound. The current was taken from these machines to a switchboard and carried down the shaft by insulated cable, fastened to insulators, the insulators being fixed to the buntings.

A three-throw pump coupled by gearing to a 40-H.P. motor was placed 1,357 yards from the shaft bottom. The pump had to deal with 150 gallons per minute, against a vertical head of 270 ft.

At a distance of 1,290 yards from the shaft bottom, an endless haulage machine was erected. In this instance also the motor was direct coupled to the haulage by means of gearing.

1,500 yards from the haulage, or a distance of 2,790 yards from the shaft bottom, the winding engine was placed. This consisted of a motor direct coupled through gearing to the winding drum, the depth of the staple being 144 ft.

It will interest your readers to know that the whole of this plant, with the exception of the generating station, is running satisfactorily to-day. The generating station is now shut down, as the colliery company take their energy from the Durham Collieries Electric Power Co., Ltd., but the whole plant was running as recently as three months ago.

Now that the question of electric winding is receiving so much attention, I think it will interest your correspondent to know that an electric winding engine, although certainly only a small one, was installed 15 years ago and is working to-day.

R. G. B.

Newcastle-on-Tyne, *July* 31*st*, 1906.

Wireless Telegraphy.

In various articles on wireless telegraphy I have attributed the invention of the alternating-current dynamo with closed-circuited movable coil to Prof. Elihu Thomson on the strength of Prof. Elihu Thomson's U.S. patent 363,185, filed January 26th, 1887, issued May 17th, 1887, and had obtained a licence from Prof. Elihu Thomson for the use of this device, as modified by me for telegraphic work, for use in wireless telegraphy.

Prof. Thomson, in the specification referred to, very specifically claims to be the inventor of this device, and states therein :—

"My present invention depends upon the discovery made by me that through the induction exercised by an alternating current or magnetic field upon a closed circuit of low resistance and high self-induction forming another coil or closed band, and through the self-induction of the electric currents set up in the latter, a repulsive action is established, resulting in a tendency of the closed-circuit coil or conductor to move away from its inducing field or to set itself at an angle to the inducing field."

In the drawings accompanying the specification Prof. Thomson shows a fixed and a movable coil placed at an angle to each other, the one short-circuited and the other carrying an alternating current.

Dr. Fleming in his book on "The Principles of Electric Wave Telegraphy," page 510 and elsewhere, states specifically that this phenomenon was discovered by him in 1887. Being desirous of giving the proper credit to the inventor of this device, I desire to obtain, through the columns of your paper, any information having a bearing upon the subject, and more particularly if there is any publication by Dr. Fleming prior to January 26th, 1887, the date of Prof. Elihu Thomson's publication, in which this device is described.

Reginald A. Fessenden.

Brant Rock, Mass., U.S.A., *July* 21*st*, 1906.

Industrial Power Supply from Municipal Stations.

I should like to be allowed to make some observations on the article by Mr. F. H. Corson in your issue of July 27th on "Industrial Power Supply from Municipal Stations," as I think the conclusions he draws are entirely erroneous.

In the working out of a particular case which is to prove that a municipality, or even an old-established station for a matter of that, cannot profitably supply power at a cheap rate, Mr. Carson makes a false assumption which entirely invalidates his argument. The fallacy is this, that because the mean capital expenditure of lighting stations in the past has been something like £70 per KW., therefore, for all fresh business that a municipality takes on it has to pay £70 per KW. for its plant.

It is hardly necessary to point out that the high capital expenditure was due to pioneer work, which involved high prices and experience dearly bought, but there is no reason whatever for this to continue, and I maintain that in most cases an existing municipal undertaking can increase its capacity at a considerably less capital cost than a power station could be put down for. It need pay no more for its plant, and in many cases there will be room in the existing buildings, new offices are not required, and additions can probably be made to mains for less than the cost of laying new ones.

If the station has been run profitably with mainly a lighting load, and is able to stand the capital of £70 per KW.,

there is no reason for saddling the proposed power supply with part of the cost of this old capital expenditure.

It is sufficient if it can provide for a return on the new capital outlay that is necessary for its production.

To put the matter in another way, the question that a municipality has to consider when the opportunity of a large power supply occurs is, whether it will be better off with it or without it; that is to say, will the receipts from the power load more than cover the extra cost involved?

A certain revenue can be obtained; probably not more than ·75d. per unit at the most. It will be necessary to provide additional machinery and probably to spend a considerable sum on mains. The total cost of this additional outlay must be taken out carefully and a proper allowance made for interest, depreciation, &c. Then the working expenses must be considered in the same way, as to what will be the additional expense incurred, and it will generally be found that the extra expense is small compared with the present cost per unit. Coal is the only serious item, and even in places where this is dearest, the cost of actual generation, omitting standing losses, will not be more than ·2d. or ·25d. per unit. There will probably be practically no increase in the wages, and very little in the repairs.

I have recently had to consider this question in connection with the supply to two large firms in this city, each of which was prepared to take from 200,000 to 300,000 units per annum at ¾d. per unit, each requiring about 100 KW.

This is the way I regard it:—

In order to supply them, we shall have to provide additional plant, *i.e.*, engine, dynamo, boilers, switchboards, &c., not at present, but in a year or two; no new buildings will be required, as owing to the substitution of large sets for small, there is room for any amount that may be required. The new plant can be obtained for £10 to £12 per kilowatt, so that at the most £2,400 is required on this account. Mains will involve about £3,400 more, say, £6,000 altogether. Allowing 10 per cent. for interest and depreciation, we have £600 per annum. Then as to extra running expenses, I allow ·25d. per unit for coal. There will be no increase whatever in the staff, and oil and repairs are easily covered by ·10d. This brings the extra working expenses to £700, so that after making full allowance, there is £200 to the good out of the £1,500. As a matter of fact, there will probably be a good deal more, as the expenditure on the mains is sufficient for a considerably greater load, and there is ample margin in the allowance for working expenses.

This is one case only, and other considerations might arise in other circumstances, but I think it shows that an existing supply station can take on power loads at low rates, and still have something to spare which benefits the undertaking as a whole.

It may be urged that this way of looking at the matter is not fair to other consumers, but my contention is that they are better off by such additions to the load, as whatever margin there is beyond the actual out-of-pocket expenses goes to help the general account, and as further economies are attained through an increase in the output, this margin will become greater, and will be sufficient to bear the full share of other expenses.

F. M. Long,
City Electrical Engineer.

Norwich, *July* 31*st*, 1906.

Gas v. Electricity.

I note that Mr. Abraham has replied to my criticism, and I quite agree that the jerry-wiring contractor deserves a great deal more abuse than he gets, for he has done more harm to the industry than ever Dr. Auer von Welsbach has done, but I wish still to point out that there are others. I regret, however, that Mr. Abraham has taken one of my remarks personally. I did not for one moment suppose him personally "ignorant enough" (I have to thank Mr. Abraham for stating the matter so clearly) to think that "no contractor was worthy of being classed as a member of the electrical profession." But I have come across that "ignorant" supposition so often—the "*only* a contractor" expression—that the opening which he, no doubt, inadvertently gave was too good to pass by.

Mr. Abraham cannot conceive of anyone being fool enough to worry a contractor to bring down the first cost of an installation in the way I mentioned in my previous communication. Well, it is not an *actual* case, but is sufficiently accurate for comparative purposes, and I can go further and say that out of the thousands of estimates made out by my firm and the hundreds of contracts executed during the past eight years, all that have really been carried out on the most economical *current-cost* basis could be reckoned in *tens*. And this was all due to the fact that the first cost had to be kept low.

Now, my powers of persuasion may be at fault, but certainly the lack of success has not been due to want of informing our clients—prospective and actual—and hence I thought the idea of giving "two quotations" a somewhat naive suggestion.

Mr. Abraham has not, however, touched on what I consider the vital point of the whole question, and that is, that public bodies accept the lowest tender given them with scarcely a thought as to the standing—electrically, I mean—of the firm quoting, and then trust to their consultant or electrical inspector to see that the work is well carried out. Such a policy is bad for the contracting business because its *inevitable* result is to force good contractors into doing a second-rate job; it is bad for the contractor who gets the work, because he must scamp it in order to make ends meet; it is bad for the consultant, who cannot feel any satisfaction in the complete installation, and it is bad for the ratepayers, who are left with a job which falls to pieces in a year or two. Such folly in any body of, presumably, business men who have the guidance of, presumably, an electrical expert is inexcusable. If the consultant estimates a certain installation according to his own specification to cost £2,500, and the tenders received run from £1,400 to £4,000, what should the selecting committee do? If they select the £1,400 tender, my opinion of them is that they must be either knaves or fools, or both, and there is a strong presumption that the knavery is in excess of the folly. Such a course of action on the part of any committee is, I should think, a most insulting form of censuring their engineer, besides being an object lesson on commercial *immorality*.

Now, facts such as the above get noised abroad, and the average man gets the idea that the cheapest offerer will give him as good and satisfactory a job as the dearest, with the result that he accepts the jerry wireman's offer and in 12 months returns to gas.

That is the sequence of events independent altogether of whether the firm who quoted low for the supposed public building were a good firm or a bad one. I know that we all are liable to make mistakes occasionally in estimating, and a good firm honestly quoting for a good job may conceivably, through some clerical or other blunder, find themselves as far out as in the instance given. But this is my contention, that such a price is so obviously wrong that no body of men can be justified in taking advantage of another's mistake in such a fashion.

I much fear, however, that the millennium will have dawned ere such a spirit of business morality, fair play and common-sense can be expected to animate the breast of Bumbledom. Even the "greatest municipality on earth" are not above snatching at a "bargain," so what *can* you expect from "the man in the street?"

John D. MacKenzie.

Glasgow, *July* 31*st*, 1906.

Manufacturers Selling Direct to Consumers.

It would appear from "Consumer's" letter in your last issue that, if the contractor would become a manufacturers' agent, his sins would be forgiven him; but why cannot the members of the E.C.A.—and those contractors that should be—subsidise and run a factory on a profit-sharing basis, and thus save the necessity of both manufacturers and agents having to handle and increase the cost to the consumer? Forsooth, what is equivalent to a duty of 40 per cent., plus manufacturers' profits, plus agents' commission, is worth striving to attain.

Regarding the reference to the cycle industry, it may surprise "Consumer" to learn that, though manufacturers

in some instances do supply direct, no advantage is given to the purchaser other than had he bought from a recognised middleman, and really this is the very gist of my complaint, in that electrical manufacturers do not deal thus fairly with the trade, but give practically equal terms to the jerry builder, jerry wireman, and jerry anything.

M. McBratney.

Newport, Mon., *August 4th*, 1906.

Inaccurate Electricity Meters.

The testing of new meters fresh from the manufacturer, as is commonly done, is of little value. The writer has performed several hundreds of such tests without finding a meter—excepting those damaged in transit—in which the error exceeded 2½ per cent. This is due to the entire train of wheels being in a free and unlocked position, so the test is simply that of the meter when driving the revolving element, and at the outside one-third of the train of wheels towards the end of the test. A real reliability test can only be obtained after the meter has been for, say, 12 months on circuit in a consumer's premises; then the whole train of wheels can be fairly accepted as being in gear and locked in the position in which they are destined to work.

This is only one of the many matters affecting the methods of ascertaining the value of a supply of electricity which, for many reasons, could only be adequately dealt with by a committee appointed by the I.E.E., as mentioned in your last issue by

P. T. O.

LEGAL.

Westlake *v.* St. Pancras Borough Council.

(*Concluded from page* 171.)

Mr. J. J. Bourne, M.Inst.C.E., said he had gone over the King's Road electricity works in connection with a previous action against the Council. The engines were then about 750 H.P. Witness had also visited Mr. Westlake's premises about 50 times since March last, and had noticed vibration each time, sometimes periodical and sometimes continuous. The vibration was not due to tramways or other traffic, but to the vibrating engines at the generating station. Vehicular vibration had not the same character of continuity and recurrence of beat as that caused by synchronising engines—he was speaking of the combined effect of the engines. He had seen the chimney of the works giving off sparks and dirt, and when he left the house his hands were dirty from the dirt from the works. He had made experiments with a vibration recording instrument, and had obtained records which he explained to the court.

Captain H. R. Sankey, R.E. (retired), said he had made several visits to the houses of the plaintiffs in April last, and had made experiments. He found the usual signs of vibration in the living rooms, which, in his judgment, was caused by running machinery not perfectly balanced, and he had no doubt that it came from the defendants' generating station. The question of the balancing of the engines was of very great importance. Unbalancing was caused by what were called the inertia forces not balancing amongst themselves. Six engines could be balanced, but not three. He should attribute what he saw to the steam turbines. Vibration was ordinarily produced by two or more engines running out of step. The vibration recording instrument produced was, in his judgment, perfect for the purpose. It would record actual vibration magnified probably 200 times. He was aware that great efforts had been made to balance the engines. There was a vertical deep well steam pump at Idris's works, opposite the power station, and pump power was frequently unbalanced, but the 140 H.P. horizontal engine at Idris's would not produce the vibration he had observed at plaintiffs' premises. It was impossible to dogmatise about vibration without an accurate knowledge of the subsoil. The principle of Prof. Dalby's balancing device was to introduce heavy weights to put the inertia forces in opposition to the piston.

For the defence, evidence was given by Col. Crompton and others.

His Lordship, in giving judgment, said the lapse of time before the action was fought would not prevent the right to an injunction if a nuisance were proved to exist. In the present case, however, the Court must take into consideration the fact that the alleged nuisance from dust had existed since the destructor was started; it was not alleged to be an increasing nuisance, and the plaintiffs had done nothing in the matter since 1894. The evidence of the plaintiffs on that point was vague, inaccurate and somewhat exaggerated, and he held that they had failed to prove the nuisance. With regard to vibration, it was admitted that it had existed periodically since 1903, and, in his opinion, the working of No. 3 engine led to vibration, which Col. Crompton had admitted might be acknowledged to be a nuisance. Taking that admission, together with the plaintiffs' expert evidence, he thought that legal nuisance existed at the date of the writ. The defendants had discontinued the use of No. 3 engine, and had stated that it would not be used again, but the fact that the nuisance existed at the date of the writ entitled the plaintiffs to an injunction restraining the defendants from working No. 3 or any other engine so as to cause a nuisance to the plaintiffs. That entitled the plaintiffs to the costs of the action except so far as they had been increased by their claim in respect of the dust destructor. There would be a set off of the latter against the costs of the action, and defendants would pay the balance.

The Workmen's Compensation Act.

The National Telephone Co. was proceeded against by the widow of an employé named Deakin to recover £250 damages for the death of her husband, who in April was working on one of the company's poles, when he fell a distance of over 50 ft., and was killed. A claim at common law had been disallowed, and it was then contended that the plaintiff could recover under the Workmen's Compensation Act. Judge Lumley Smith decided that the accident did not happen during the repair of a building, and the plaintiff, therefore, had no case. Each party to pay their own costs.—*The Times.*

London United Tramways, Ltd., and Road Car Co., Ltd., *v.* Walters.

In the Court of Appeal on August 2nd the London United Tramways, Ltd., and the Road Car Co., Ltd., appealed against a decision by Mr. Justice Grantham awarding Mr. and Mrs. Walters £350 for injuries sustained in a collision between a tram and a motor-'bus near Shepherd's Bush tube station in June, 1905.

The Master of the Rolls said the admissions in the evidence might very well support the view that each defendant had been guilty of negligence, and the jury were entitled to return a verdict against both defendants, from whose joint act of negligence the plaintiffs had suffered. There was certainly nothing in the summing up that was calculated to mislead the jury, nor was there anything omitted Consequently this bi-lateral appeal failed.

The Lords Justices concurred, and both appeals were dismissed with costs.

Telephone Co. and their Wires.

Motion Against a Yorkshire Co.

On Wednesday, in the Chancery Division, the case of the National Telephone Co. *v.* the Wakefield and District Light Railways Co. was again mentioned to Mr. Justice Swinfen Eady.

Mr. Eve, K.C., observed that there was a direct conflict of evidence as to the respective rights of the parties to use the highway, and the matter could not be disposed of on motion. He, therefore, asked that it should stand over until the trial of the action.

Mr. Macnaghten, K.C., for defendants, said that the case raised an important question of the construction of an Act of Parliament. The Light Railway Co. were putting up standards for the purposes of electric traction and the Telephone Co. had their wires adjoining. The trams would be running in about three weeks.

His Lordship acceded to Mr. Eve's application, and reserved the question of the costs of the motion.

BUSINESS NOTES.

Improvements in the Tantalum Lamp.—Messrs. Siemens Bros.' Dynamo Works, Ltd., inform us that several improvements have recently been made in the tantalum lamp, of which they are the sole importers. The average useful life is now at least 600 hours for the H-type standard lamp, and 800 hours for the L-type lamp, while the average total life may be taken as equal to that of the ordinary glow lamp. These figures have been tentatively adopted for commercial purposes, although actual tests which have recently been made on a large scale at the works show even better results. Experiments have shown that by obscuring the pip end of the tantalum lamp, a large amount of the light which would otherwise be thrown upwards and dispersed inefficiently, is now concentrated vertically downwards; in fact, the downward illumination is found to have been increased by about 100 per cent., without in any way reducing the horizontal illumination. It has been decided, therefore, to supply tantalum lamps in future with clear glass bulbs having the pip end obscured. If bulbs are required of completely clear or completely obscured glass, they can be specially supplied to order. The tantalum Sun lamp will also be supplied with pip end obscured, and other types will be specially made. The reflective power of these lamps is particularly marked if they are used in connection with certain patterns of holophane glass shades, of which Messrs. Siemens Bros.' Dynamo Works, Ltd., keep stocks.

Spain.—La Société des Tramways et Electricité de Bilbao is the name of a company which has lately been formed in Brussels, with a capital of £300,000, to establish and work central electricity generating stations and electric tramways in the Bilbao district of Spain.

Catalogues and Lists. — Siemens Bros.' Dynamo Works, Ltd., York Mansions, London, S.W.—The following price lists:—2A, Alternating current generators and motors (Part I, ventilated motors); 5A, Meters and meter testing boards (Part I, meter); 15D, Tantalum lamps; 18, Switchboard meters; 19, Apparatus for determining losses in core plates; 20, Small pattern moving coil instruments. Price List 2A deals with ventilated V-type induction motors and full technical information regarding these is given. Everything required to be known about the outputs and price of a machine can be found on one line, and the dimensions, weights and prices of spare parts are listed separately at the end and referred to by cross references. Price List 5A covers the more important types of Siemens-Schuckert meters suitable for use in this country. Each type is accompanied by a short specification, together with weights in lbs. and kilogrammes. Special attention is directed to Type A2 meters and the W1Q, W2B and W2 meters for alternating work. Meter transformers are shown, and the company are prepared to quote on application for double tariff meters, watt-hour meters with maximum demand indicators, double tariff counters, battery meters and traction meters. Price Sheet 15D of tantalum lamps contains modifications of the tantalum Sun lamp, which result in a reduction in price. Price Sheet 18 deals with switchboard meters; these are of the GW type, but provided with brass and glass covers. Price Sheet 19 covers apparatus of considerable interest to makers of core plates, to electrical engineering works and to technical colleges, for testing the quality of armature and transformer plates. Three different apparatus are described and listed with all the necessary accessories. Price Sheet 20 deals with some new small pattern moving-coil instruments, including ammeters and voltmeters with 4-in. dials, small edgewise instruments, and combined ammeters and voltmeters in aluminium cases, which are made in two forms:—(1) With protected terminals for motor-cars; and (2) for switchboard use.

The Electrical Co., Ltd., Charing Cross Road, W.C.—Card showing their non-magnetic meter testing chronograph, divided in $\frac{1}{5}$ seconds and legible to $\frac{1}{16}$ second.

A. H. Hunt, 115-117, Cannon Street, E.C.—Leaflet describing the "Sun" patent portable soldering stove, an ingenious copper bit and charcoal stove combined.

Chatwood's Patent Safe and Lock Co., Ltd., 56, Gracechurch Street, E.C.—Leaflets describing their safety cash and deed boxes, steel strong rooms, &c.

Simplex Conduits, Ltd., 11, Queen Victoria Street, E.C.—Leaflet No. 161 describing the new Simplex patent flush mounting boxes for switches, ceiling roses, &c.

General Electric de France, Ltd., 11 bis, Rue de Maubeuge, Paris.—Pamphlets sections H and M, the former dealing with electric heating and cooking apparatus, Robertson lamps, &c., and the latter with measuring instruments ranging from "industrial" ammeters and voltmeters to Stanley d'Arsonval instruments of precision, recording apparatus, portable apparatus and automobile accessories.

Book Notices.—"The Physical Review," Vol. XXIII, No. 1, July, 1906. Lancaster, Pa., and London: The Macmillan Co.

"Journal of the Röntgen Society," Vol. III, No. 9, July, 1906. London: Smith & Ebbs, Ltd.

"Bulletin of the Imperial Institute," Vol. IV, No. 2, 1906. London: Eyre & Spottiswoode, or the Imperial Institute.

"The School of Mines Quarterly," Vol. XXVII, No. 3, April, 1906. New York City: Columbia University. 50 cents.

"Atti della Associazione Elettrotecnica Italiana, Sede Centrale," Vol. X, January, February, March and April, 1906. Milan: Via Tommaso Grossi 2.

"Etude de la Résonance des Systèmes d'Antennes dans la Telegraphie sans Fil." By M. Camille Tissot. Paris: Gauthier-Villars.

"Etat Actuel des Industries Electriques." Conferences faites sous les Auspices de la Société Française de Physique et de la Société d'Encouragement pour l'Industrie Nationale. Paris: Gauthier-Villars. 5 fr.

"Modern Buildings: Their Planning, Construction and Equipment." By G. A. T. Middleton, A.R.I.B.A. Vol. III (including Heating, Ventilating and Lighting). London: The Caxton Publishing Co. 10s. 6d. net.

Trade Announcements.—Messrs. Arc Lamps, Ltd., notify us that their works are closed for stocktaking from August 3rd to August 12th inclusive.

Mr. G. R. Peers has entered into a partnership with Messrs. Copland & Cardin, of Newport, Mon., and his future address will be 16, John Dalton Street, Manchester. The firm will be known as Messrs. Peers, Copland & Cardin.

Canada.—The Canadian Westinghouse Co., of Hamilton, Ont., has secured an important contract for important additions to the extensive mining plant of the Granby Consolidated Mining and Smelting Co., Ltd., at Granby, British Columbia. This includes a 150-H.P. double-drum electric hoist, with a capacity of 10,000 lb. raised at the rate of 700 ft. per minute. The shipping weight of this machine will be more than 50,000 lb.

Liquid Air.—On Wednesday last week a demonstration took place at the works of the Liquid Air Power and Automobile Co., Ltd., of the process invented by Mr. Hans Knudsen for the commercial manufacture of liquid air. By this means it is proposed to produce pure liquid oxygen at a low cost—from 3s. to 5s. per gallon, equal to 120 cb. ft. of oxygen gas—as well as liquid air for blasting in coal mines and for motive power. The liquid oxygen is also proposed for welding iron and steel, including even boiler plates and plates for ship-building. We do not like to damp the ardour of enthusiastic inventors, but we fear that the only important application of the process will be the production of oxygen.

LIGHTING and POWER NOTES.

Acton.—The U.D.C. has decided to offer consumers of energy for power and heating purposes, as from October 1st next, an alternative maximum demand rate, namely, 3d. per unit for the first two hours' consumption, and 1d. per unit after. The flat rate of 2d. per unit is to remain as at present.

Mr. J. Martin Blair, the resident electrical engineer to the Council has issued a neat little booklet giving some useful notes on electric lighting. Consumers and others in the district should procure a copy.

Aspull.—Steps are to be taken to secure an extension of the U.D.C.'s E.L. order.

Australia.—A large electric power scheme proposed by Messrs. J. M. & H. E. Coane, civil engineers, of Melbourne, and Mr. E. K. Scott, of the Sydney University, has been for some time under the consideration of the Government. It is proposed to build a reservoir, computed to be the largest in the world, at Trawool, by constructing a wall 175 ft. high, connecting two hills in close proximity, between which, in a defile, the Goulburn River flows. If this is done, it is estimated that 750,000,000,000 cb. ft. of water may be banked up, of which 60,000,000,000 cb. ft. will be above the lowest level at which the water may be used for generating purposes.

Barnstaple.—The T.C. has decided to allow consumers of energy for lighting, discounts of from 5 per cent. on accounts of £5 to £25, to 10 per cent. on accounts above £50.

Brighouse.—The Corporation has decided upon a scheme of electric lighting for the borough, at an estimated cost of £25,000. An order is to be applied for next session. It is stated that the recently burnt out Alexandra Mill is to be purchased for £1,800 as a site for an electricity and destructor works.

Bristol.—The results of the past year's working of the Corporation electricity undertaking are as follows. The figures for 1905 are given for comparison:—

Year ended March 25th	1906.	1905.
Total revenue	£70,664	£69,687
„ working costs	30,785	31,936
Gross profit	39,879	37,751
Interest	20,015	17,168
Sinking fund	13,749	9,723
Net profit	6,115	10,860
No. of 8-C.P. lamps	302,841	274,176
H.P. of motors and heating apparatus	3,972 H.P.	3,213 H.P.
Number of consumers	2,827	2,677
Units sold	5,810,968	5,217,528
Capacity of plant	9,050 KW.	5,700 KW.
Maximum load	4,840 KW.	4,284 KW.
Average price obtained per unit	2·693d.	2·962d.
Total working cost per unit	1·188d.	1·379d.
Capital expended	£671,617	£590,984

From the above credit balance of £6,115 (plus £952 from last account, £897 interest from bankers, and £514, an instalment of outstanding debt in respect of assets depreciated to March, 1905), £2,500 was placed to reserve, for renewals, and the balance, £5,978, carried forward.

Burnley.—At a recent T.C. meeting, Councillor Marshall moved that a minute be referred back to the Electricity Committee which informed the Tradesmen's Association that there could be no further reduction in the price of energy. He compared gas and electricity to the advantage of the latter, and stated that the price was prohibitive against its more general adoption for shops and houses. He thought it was a case were large profits might be dispensed with in order to benefit the public with a cheap and healthier illuminating source. He found that only 1 in 30 ratepayers used electricity, and why, he asked, should this one help to put £4,000 to the rates for the benefit of the other 29? The chairman observed that the profits were allocated for this year, and they could make no alteration now. If they were warranted in reducing the price when the next estimates were considered, he would be glad to see it reduced. Councillor Marshall was persuaded to withdraw his motion.

Canada.—Toronto.—The City Council has applied to the Hydro-Electric Power Commission for a supply of electrical energy, and the latter has invited the big power companies at Niagara to quote prices for a minimum supply of energy to the extent of 10,000 H.P. delivered at Toronto. Our Toronto correspondent says that it will depend upon the tenders whether the Commission will expropriate the energy at a price to be fixed by itself or erect a plant in competition with the existing companies.

Ontario and Electric Power.—A conference attended by delegates from all the principal towns in Western Ontario, was held at Galt on July 24th for the purpose of considering the Power Bill passed at the last session of the Ontario legislature. The representatives of the various municipalities appeared to be practically unanimous in favour of the scheme, and were anxious to set to work with the object of obtaining a supply of electric power at the earliest possible moment. Although the meeting was largely for the purpose of familiarising the delegates with the provisions of

the Bill, they decided to act promptly and formed an organisation to be known as the Western Ontario Municipalities Niagara Power Union, the object of which is to secure the co-operation of the various municipalities.

MONTREAL.—Contract work on the new power station at Soulanges for the Montreal Light, Heat and Power Co. is proceeding apace. Water will be taken from the Soulanges Canal and will fall 55 ft. to the water wheels, afterwards passing through the tail race into the River St. Lawrence. The contract includes the construction of a canal about half a mile long and 160 ft. wide, and involves the excavation of some 300,000 cb. ft. The total development will be about 20,000 H.P., consisting of four units of 5,000 H.P. each.

GREENWOOD, BRITISH COLUMBIA.—Surveys are being made for the extension of the transmission line from Greenwood to the Mother Lode Mines of the British Columbia Copper Co. and to the Boundary Falls smelter of the Dominion Copper Co., each being a distance of about four miles from the mining township. Both companies will substitute electricity for steam power on the completion of the lines. The work is being performed by the British Columbia Contracting and Distributing Co., a subsidiary company of the West Kootenay Power and Light Co.

Chorley.—Messrs. A. C. Tupp and W. A. Mitchell have informed the T.C. that they intend applying for a prov. order for electric lighting. The Council's order has been revoked.

Colchester.—The T.C. has applied to the L.G.B. for a loan of £11,000 for electricity purposes, made up as follows:—Loans overspent, £1,553; expended but not provided for in previous loans, £1,110; conversion of factory into bunkers, stores and fitting shops, £150; superheaters, £910; engines, &c., £2,056; meters, £1,650; service mains and terminal boxes, £688; mains extensions, £1,430; road work, &c., £750; machine tools, £250; contingencies, £453.

Continental Notes.—ITALY.—Application has been made to the Turin provincial authorities for a concession to put down a water-power plant on the River Torto at Volvere, for generating electrical energy for light and power purposes in the town.

FRANCE.—Active negotiations have been going forward between the municipality of Chaumont and the Société des Usines à Gaz du Nord et de l'Est on the subject of the installation of the electric light. The company undertakes within a year of the signing of the agreement to supply electricity to subscribers dwelling within a certain radius.

The Lille Electric Lighting Co. has decided to set up a 6,000 H.P. electric generating station at Lomme, to be eventually increased to 10,000 H.P. The station will be furnished with the latest machinery, including especially steam turbine generators on a new system. The Lille station will furnish energy for all the requirements of public and private lighting, heating and power in the city of Lille.

Coventry.—The T.C. has applied to the L.G.B. for loans of £2,000 for spare pipes for E.L. cables, and £432 for new posts and electric lamps.

Exeter.—A L.G.B. inquiry was held on Tuesday in regard to the excess expenditure on the electric light station, which amounted to a net sum of £2,600. The T.C. is applying for leave to borrow two other sums, viz:—£2,910 in respect of cables, transformers, meters, &c., for the extension of the electricity supply in the parish of Heavitree; and a further sum of £9,400 for past and prospective extensions of cables and transformer stations within the area.

Farnworth.—A correspondent learns that Messrs. Hardman, cotton spinners, Longcauseway, Farnworth, are considering the building of another mill adjoining their present one and working the same by electricity.

Hanley.—In order to popularise electricity the electrical engineer has suggested to the T.C. that wiring contractors engaged solely in electrical work should be supplied with energy at 1d. per unit, on condition that it is used for display purposes. This is an alternative to the opening of a show-room, which the electrical engineer says he cannot recommend.

India.—CALCUTTA.—Our Indian correspondent writes:—The Calcutta Electric Supply Corporation is in a very prosperous condition, the number of consumers now connected to the mains being 2,451, with a total consumption of 3,548,229 units during the year. Originally all the company's feeders and distributors were overhead, but owing to lightning and other troubles, the feeders are now underground, and the distributors are being gradually treated in a like manner. Until June last no serious breakdown had been experienced. On two consecutive days during that month, however, the current was off the mains for several hours, owing, it is alleged, to "shorts" in the main feeders. These appear to have developed simultaneously in four different parts of the town. Various lamps and fans were burnt out owing to an excessive rise in voltage on one side of the system, and considerable inconvenience was felt by users of fans. With the thermometer above the 100, an electric punkah is almost a necessity to one's existence. The charges for energy in Calcutta are considered excessively high, and there is a general feeling that the municipal authority should move in the matter. The Bengal Government, however, do not favour the suggestion of a rival concern to the supply company; and arguing from the method in which municipal matters are managed generally in Calcutta, it would certainly be a grave mistake to allow the City Fathers to have a finger in the electric pie, except, perhaps, in order to induce the company to lower its rates. Electrical business generally is dull just now; after a rich harvest reaped by wiring contractors for several years back, things are steadying down to normal. Where 30 and even 40 rupees per point were easily obtained in the days of the boom, it is now difficult to get beyond 20 rupees for the same class of work; and many of the old and high-class firms who imported specialists from home to supervise wiring, are now gradually dropping out and leaving the field to the native bazaar contractor, who is generally as incompetent as he is unscrupulous.

DELHI.—A new power station is to be put down by the East Indian Railway to light its station offices, locomotive and traffic yards, &c.

POWER SCHEMES.—The Hooghly power scheme has made its preliminary bow to the public, and informs all whom it may concern that it proposes transmitting power from Hugli, where coal can be bought cheaply, along the river, supplying the numerous jute mills *en route* to Calcutta and Howrah.

ASANSOL.—Messrs. Hoare Miller, of Calcutta, have recently given notice that they intend applying to the Government of India for leave to transmit electrical energy from the coalfield district of Asansol to the various outlying districts within a radius of 60 miles.

BARRACKPORE.—Messrs. Kilburn & Co., managing agents for the Calcutta Electric Supply Corporation, have recently equipped a small three-wire plant in Barrackpore. About three miles of aerial distributors are laid, and as the present Viceroy intends to spend a good deal of his time at his residence there, it is anticipated that the place will become more popular as a residential suburb of Calcutta. The wiring of Government House is already in hand.

London.—GREENWICH.—The B.C. at its last meeting passed the following resolutions:—(1) "That with a view to the better ventilation of the sewers in the borough, and the purifying of the atmosphere in such sewers, it be referred to the Public Health Committee to obtain the opinion of an expert as to the desirability and probable cost of introducing ozone (electrically produced) into sewers, together with sufficient movement and regulation of the sewer air by means of electric fans." (2) "That in view of the evils likely to ensue if the main 11 ft. 6 in. barrel sewers now being constructed through this borough are ventilated by surface ventilators in the ordinary way, the L.C.C. be requested to take into consideration the purification of the air in and ventilation of such sewers by means of ozone generated electrically, assisted by electric fans, and that the L.C.C. be requested, if this method cannot be adopted, to arrange: (*a*) For ventilating these sewers by raised ventilators; (*b*) for reducing the number of such ventilators so far as possible, and enlarging, if and so far as may be necessary, the apertures to the ventilators required; and (*c*) for using electrical fans or other appliances for dispersing the gases, and for employing purifying appliances for removing deleterious effects, and that a copy of this resolution be forwarded to the L.C.C., and to the Borough Councils of Bermondsey, Deptford, Lewisham and Woolwich."

L.C.C.—As mentioned a week ago, the County Council proposes to direct the attention of the B. of T. to the necessity which, in the opinion of the Council, exists for further legislation so as to provide that no electricity meter shall be fixed for use unless it has been previously officially tested and stamped by the Council. In a report which led to the submission of a recommendation to this effect, the Highways Committee stated that the E.L. prov. orders make no provision for the imposition of a penalty upon an undertaker for failing to have a meter certified, and the tests made by supply companies or borough councils could not be accepted by consumers as impartial. During 1905 the County Council tested 2,396 new meters; of these 1,226 were passed as accurate at the first test, 410 were passed as accurate after adjustment and further testing, while 760 were rejected as inaccurate, the respective proportions being 51 per cent., 17 per cent. and 32 per cent. The report proceeded to refer to the testing of meters by certain electric lighting authorities, a practice which is considered not to be in accordance with the Electric Lighting Acts. Under the Sale of Gas Act, 1859, powers now exercised by the County Council are conferred, which provide for the testing by the Council of all gas meters previously to their being used, as well as for the testing of meters when in dispute when in position. The Committee suggested that an endeavour should be made to secure similar powers in respect of electricity meters, so that these should be uniformly and authoritatively tested. It appeared that the question was one that affected the amendment of the general law with regard to electricity supply, and it would have to be dealt with by means of a public Bill. In these circumstances the Committee proposed first of all to communicate with the B. of T. indicating the various points which, in their opinion, required amendment, and to place at the disposal of the Board the results obtained by the Council's work as the meter testing authority. It was then proposed to present a further report with a view to such further action being taken as might be considered necessary.

ELECTRICITY *v.* GAS.—At the half-yearly meeting of the Gas Light and Coke Co., the chairman referred at length to the competition of electricity, deprecating the fact that municipal electric lighting plants should be used for supplying street lighting, when the company's gas was available. The company ask for a "fair field and no favour," meaning, doubtless, full liberty to compare 25-year old arc lamps, with brand new high-pressure gas installations, for the benefit of newspaper readers.

Manchester.—The Chapter of the Manchester Cathedral, in consultation with the churchwardens, has decided to light the old Gothic building by electricity. The new buildings were lighted from the first by electricity.—*Manchester Guardian.*

Mountain Ash.—The U.D.C. has resolved, in the event of the South Wales Electrical Power Distribution Co. failing to carry out its contract, to generate its own electricity at the gas works. An extension of the E.L. order has been applied for.

Salford.—The Town Council at its next meeting will consider a recommendation of the Electricity Committee that application be made to the L.G.B. for additional borrowing powers to the extent of £25,000 for mains and services and sundry extensions, and £10,000 for the hiring out of motors. Of the first-named sum it is proposed to apply £24,000 to extensions of mains and services for consumers, and to allot £1,000 for sundry capital expenditure. The loan to which mains and services are at present being allocated is also £25,000, and of this £22,274 had been expended up to May 31st last. Since that date approximately £400 additional has been spent, and the Committee is of opinion that it is advisable now to seek further borrowing powers. Since the previous sanction was obtained great progress has been made in the development of the undertaking; the power output has increased 150 per cent. in two years, and the lighting output 44 per cent., and at the present time the development is going on at a still more rapid pace. It is expected that the proposed loan will meet the Committee's requirements for at least two years. Motor hiring has strongly developed during the past four years. The loan to which capital expenditure on motors is at present being allocated is one of £10,000, and of this sum £7,339 has already been spent.

Scotch Power Schemes.—There is another large power scheme in contemplation in the Highlands of Scotland. It is of a similar nature to that at present in hand at Loch Leven. The Marquis of Breadalbane has been approached regarding the development of certain rivers on his estates. It is not, however, regarded as probable that Lord Breadalbane will give any assistance. A syndicate is also endeavouring to secure the use of the waters of Loch Awe.

South Wales.—A meeting of the Committee of Colliery Owners who are consumers of power supplied by the South Wales Electrical Power Distribution Co. was held recently in Cardiff. After considering the proposed new scale of charges as suggested by Mr. Merz, the technical adviser of the debenture holders of the Power Co., and after hearing correspondence from Mr. Chamen, the general manager, as to the future supply of electricity for power, the following resolution was passed:—"This meeting, having heard Mr. Chamen's explanation of the method of ascertaining the maximum horse power for the quarter under Mr. Merz's scale, is of opinion that the scale is a reasonable one, and subject to a satisfactory agreement as to detail terms the meeting is favourably disposed to support the Power Co.'s scheme, and requests Mr. Chamen to obtain from the various consumers the horse power they are likely to require and guarantee."

Stourbridge.—The U.D.C. has received an intimation from the B. of T. that the question of revoking the E.L. order will be deferred pending the submission of the draft deed transferring the order to a company.

TRAMWAY and RAILWAY NOTES.

Barton (Lancs.).—The Lancashire United Tramways Co. having intimated its willingness to repay the cost of promoting an order for the construction of tramways at Clifton, the R.D.C. has decided to prepare a lease of the line from Newton and Pendlebury to Kearsley to the company.

Bournemouth.—A new electric tramway connecting Bournemouth with Parkstone was inspected by the B. of T. on the 3rd inst. and afterwards formally opened for traffic.

Burnley.—The manager (Mr. H. Mozley) of the Corporation electrical tramways, in his annual report, states that there was an increase of 1,055,325 passengers, and £3,966 receipts, with a decreased mileage of 28,889. The Corporation had decided to obtain powers to use motor-omnibuses within and without the borough, and powers to extend the tramway system to Harle Syke, a developing suburb of the town.

Bury.—The Bury T.C. has given instructions for estimates to be prepared for the extension of the electric tramways to Bolton.

Clifton (Lancs.).—Under an arrangement between the local authority and the Lancashire United Tramways Co. a tramway is about to be laid in the township of Clifton from the boundary at Newtown to Unity Brook, Kearsley. A 21 years' lease will be granted to the company, and the lessees will repay to the Council the expense of promoting the order.

Continental Notes.—HUNGARY.—An extraordinary change of attitude in the short period of two days is attributed to the Hungarian Ministry of Commerce. It appears that on July 26th a Bill was brought forward to authorise the construction of an electric railway from Pressburg to the Hungarian frontier, which would form a connection with the line being built between Vienna and the Hungarian frontier. The Bill proposed to sanction the formation of a company to construct the railway. To the general surprise, however, the Government withdrew the Bill on the following day, so as to cause the scheme to collapse. It is stated that the decision to abandon the project is due to the opposition of a section of the Kossuth party, who declared that the Bill was in favour of Austria.

TURKEY.—The tramways in the town of Salonica are to be converted into electrical lines.

SPAIN.—The formation of a company has been decided upon for the construction of an electric railway from Peralta to Marcilla, in the province of Navaria. Power will be supplied by the water mill at Marcilla, whose purchase has been decided upon.

Hammersmith and City Railway.—The report of the G.W. Railway for the half-year to June 30th, states that the electrification of the Hammersmith and City Railway, including the generating station at Park Royal, are so far completed that it is hoped to bring electrical working into operation in the autumn.

India.—DELHI.—"The Official Order" has been published sanctioning the taking in hand of the electric tramway undertaking, which is restricted to the area of the Delhi Municipality. The "Order" has immediate effect, and renders the authorisation of the promoters to construct the tramway complete. —*Indian Engineering.*

Keighley.—The B. of T. has extended the time for carrying out the Bradford Road tramway scheme, promoted by the T.C., until August 11th, 1907.

King's Norton and Northfield.—The U.D.C. has entered into an agreement with Birmingham Corporation for the working of the Moseley and King's Heath and the Pershore Road and Bristol Road tramways. The former will be worked by the Corporation for 20 years and the latter from 1911 to 1927. The U.D.C. will provide and maintain the permanent way and overhead equipment, and bear the cost of energy, and the Corporation will provide and maintain all rolling stock, and hand over to the U.D.C. the takings in the urban area after deducting the actual operating costs.

Kirkcaldy.—It is expected that the Kirkcaldy and Leven tramways will be ready within a few days. The line is 7¼ miles in length, and is divided into half-mile sections. The cars are divided into two compartments, the one half for smokers, and the other half for ladies and non-smokers, each car carrying 32 passengers in all. Trailer cars will also be run.

Lancashire and Yorkshire Railway.—What is believed to be the last of the claims in connection with the Hall Road disaster, was heard at the Liverpool Assizes on the 2nd inst., when John Kershaw, a cabinet maker, obtained £350 damages.

L.B. & S.C. Railway.—Speaking at the ordinary general meeting on the 1st inst., the chairman of the company, Lord Cottesloe, stated, in regard to the equipment for electrical working of the South London railway from London Bridge to Victoria, that the contract with the A.E.G., of Berlin, had been signed, and a contract for the supply of electrical energy had been made with the London Electric Supply Corporation. The preliminary work in connection with the equipment is already in hand. In reply to a short discussion, the chairman said it was very problematical whether the Channel tunnel would ever be built, and he hoped it never would be. With regard to the failure so far of the "electrification" of the Metropolitan and Metropolitan District Railways, it must be remembered, on the other hand, that the North-Eastern and the Lancashire and Yorkshire Companies had both electrified certain portions of their systems with extremely satisfactory results, and they must hope that their own experiment would turn out well.

Manchester.—Mr. G. R. Askwith, K.C., the B. of T. arbitrator in the dispute between the Manchester Corporation and its tramway employés, has given his decision against the men's demands. The men sought time and a half for all Sunday labour. Prior to the matter going to arbitration, the Committee were prepared to pay time and a quarter for hours worked over 54 hours per week, but when the men resolved upon arbitration that offer was withdrawn. The expense follows the award, so that the men not only lose their time and a quarter pay, but have to pay the costs as well. The arbitrator's conclusion was "that if the concession now asked for by the employés were granted, not only would a heavy charge be entailed upon the ratepayers, but also the employés, beyond the present high rate of wages paid to them by the Corporation, and the previous concessions granted to them from time to time would receive a benefit out of the undertaking quite out of proportion to that to which they are reasonably entitled."

Newcastle-on-Tyne.—Our correspondent understands that for the year ended March 31st last the total income of the Corporation tramways was £201,514 as compared with £199,571 for the previous year. The total working expenditure was £105,934 against £124,339 in 1905. Thus, while the year's income has been increased by about £2,000, the expenditure has been decreased by over £19,000. The gross profit amounted to £95,581. Out of this amount there has been paid in interest on loans £33,652; rents and other charges, £8,273; written off for uniforms, £1,440; sinking fund charges, £33,209; and £640 the cost of a prov. order, leaving a balance of £18,744. The balance in hand last year was £9,000, which was carried to the reserve account. Mr. Bowden, the auditor, now suggests that £18,744 should be carried to the same

account, which, in his opinion, would still leave £42,000 short of what the reserve fund ought to be, seeing that for the first year or two after the introduction of the electric tramways no provision was made in this direction.

London.—L.C.C.—During the storm last week a number of the cars running on the County Council system were stopped for about half an hour in consequence of the interruption of supply from the generating station at Greenwich, owing to flood.

Col. Yorke, R.E., on behalf of the B. of T., inspected on the 1st inst. the lines which have just been completed between York Road, Wandsworth, and Tooting, *viâ* Garratt Lane and Earlsfield Station, and the route was opened to the public last Saturday.

The London County Council will consider, after the summer vacation, proposals for applying to Parliament to authorise the construction of new tramways of a total length of 32½ miles. Of this mileage 26½ miles represent new lines, and 6 miles are merely connecting lines. It is also proposed to seek Parliamentary sanction to lower roads in connection with the reconstruction of the tramways in Wandsworth Road, Lavender Hill and St. John's Hill, and on the London Southern Tramways system, and also to reconstruct these particular lines for electric traction. The following is a list of the projected new lines which are to be put forward for authorisation by Parliament:—

1. From the tramways in Hampstead Road, *via* George Street and Euston Road, Eversholt Street and Seymour Street (single line alternative routes), Upper Woburn Place and Tavistock Square (double lines), Woburn Place, Tavistock Square, Upper Bedford Place and Russell Square (single line alternative routes), and Russell Square and Southampton Row (double lines) to tramway subway.
2. From the tramway terminus in Hampstead Road, across Euston Road and along Tottenham Court Road to Francis Street, and single lines along Tottenham Court Road, New Oxford Street, Bloomsbury Street, Gower Street and Francis Street to Tottenham Court Road.
3. From the tramway subway, *via* Vernon Place, Hart Street and New Oxford Street to Bloomsbury Street.
4. From the terminus at East Hill, Wandsworth, *via* East Hill (double lines), High Street, Wandsworth, Buckhold Road, a new road, and Broomhill Road (single line), North Street, York Road, High Street, Wandsworth (single line), West Hill, Upper Richmond Road (double lines), Oxford Road, Putney Bridge Road and High Street, Putney (single lines), to join the authorised tramways at Putney Bridge.
5. A line from the terminus of authorised tramways, Forest Hill, *via* Dartmouth Road, Sydenham Park Road, Sydenham Park, Jew's Walk, West Hill and Crystal Palace Parade to join the proposed tramway there.
6. Double line from Marble Arch, *via* Edgware Road, Maida Vale and Hill, High Road, Kilburn, and Shoot-up-Hill, to the county boundary at Cricklewood.
7. From the terminus of the London Southern Tramways system in Norwood Road to the Crystal Palace, *via* Knight's Hill Road and Crown Hill (single line), High Street and Elder Road (single line), and Crown Hill and Central Hill (double line), and Westow Hill (single line).
8. Loop line along Westow Street and Church Road.
9. From Pancras Road, *via* Midland Road and Euston Road to King's Cross.
10. From Seven Sisters Road to Stamford Hill, *via* Amhurst Park.
11. From tramways in Lea Bridge Road, *via* that thoroughfare to Lower Clapton Road, with loop line *via* Thistlewaite Road and Cornthwaite Road.
12. From tramways at Streatham, *via* Streatham High Road and Streatham Common to the county boundary at Norbury.
13. Single line from High Street, Stoke Newington, *via* Ridley Road and Dalston Lane to Amhurst Road.
14. Single line from Dalston Lane to Mare Street, *via* Amhurst Road.
15. Single line from Amhurst Road to Mare Street, *via* Dalston Lane.
16. Single line from Essex Road to Kingsland Road, *via* Englefield Road and Stanford Road.
17. Single line along Curtain Road to provide an alternative route to existing single tramways in Old Street.
18. Single line along Harwar Street to provide an alternative route to existing single line tramways in Kingsland Road.
19. Construction of loop line from Wandsworth Road to Queen's Road, Battersea, *via* Silverthorne Road, Heath Road and a new road.
20. Loop line along Poplar Walk and Lowden Road.
21. Loop line along Herne Hill Road and Wanlass Road.

The underground conduit system is proposed for 15 of the lines, while the overhead trolley is suggested for Nos. 5, 7, 8, 11, 20 and 21.

Two L.C.C. tramcars came into collision at Catford on August 6th. Fortunately the accident was not attended with very serious consequences to the passengers. A heavily laden car was following another at Rushy Green, when the leading car was stopped by signal, and was run into by the following one, several passengers being shaken.

North-Eastern Railway.—We gather from the half-yearly report of the company that the electric passenger car-mileage rose from 1,781,000 to 1,785,000 during the period in question, the expenditure on electric train working being £15,894, an increase of £70 on the corresponding period.

Paisley.—On Saturday last motormen and conductors, to the number of 120, employed by the Paisley and District Tramways Co., struck work. It appears that the men desired the reinstatement of two men, a weekly wage of 28s. for two years' service, and a 10-hour day within the 12-hour limit. Little or no inconvenience was caused, except that some of the car windows were smashed. The vacancies were filled up by shed men and other recruits.

Rawtenstall.—The T.C. has asked the Bacup and Haslingden T.C.'s to confer on the question of purchasing the tramways in the district and providing a joint generating station. The Bacup T.C. has received the proposal with favour.

Rochdale.—As in other towns in close proximity to Rochdale, the Tramways Committee has been considering a request from the men to be allowed six days' holiday per year, with pay. The Committee is of opinion that the wages paid and conditions of work are equal to, or above, the average of other Lancashire towns, and it cannot, therefore, comply with the men's request. It also refuses to pay time and a quarter for overtime.

Stirling.—The Stirling and Bridge of Allan tramways have been acquired by the National Electric Construction Co., the price being £10,000 cash and £9,470 in shares.

Stockport.—The Stockport tramway men have been agitating for some months past for a week's holiday, with pay, each year, and a guaranteed week's wages for 60 hours in six days—in other words, a weekly wage instead of payment by the hour; also time and a quarter for Sunday work, and a minimum of half a day's pay for men turning up at the depôt for extra cars. The Committee has decided to grant holidays as follows:—After one year's completed service, two days; after two years, three days; after three years, four days. The Committee does not consider it practicable to give a guaranteed week's wages for 60 hours' work in six days, nor can any change be made in the rate of pay for Sunday work; but a minimum of two hours' pay will be given to men turning up at the depôt for extra (uncertain service) cars.

Warrington and Northwich.—The Light Railway Commissioners have submitted to the B. of T. for confirmation an order extending the time for carrying out the Warrington and Northwich Light Railway Order, 1903.

Walkden.—The machinery is now being installed in the new sub-station for the Lancashire United Tramways Co., which has been erected in Manchester Road.

Wimbledon.—The London United Tramways, Ltd.'s section of tramways to Wimbledon has now been completed, and a trial run has been satisfactorily made. The new section was to be opened for traffic on Bank Holiday.

TELEGRAPH and TELEPHONE NOTES.

Africa.—The following new telegraph offices have been opened in Africa, viz., Mauritanie, in French West Africa; Caxito, in Angola; Agbor, Arigbajo, Iddo, Opeji and Wasimi, in Southern Nigeria; and Porto Seguro, in Togoland. The name of the telegraph office at Lekki, in Nigeria, has been changed to Leckie.

Hawaii Islands.—The French Consul at Honolulu, in a recent exhaustive report on the Hawaii Islands, states that since 1902 Honolulu has been in communication with San Francisco on the one side, and Manilla and Guam with an intermediate station at Midway Island on the other, by submarine cable belonging to the Commercial Pacific Cable Co., which has up to the present kept up a good service, a special boat, the *Restorer*, having been told off to keep constant watch on the line. Two extensions of the Commercial cable are under execution, one from Guam to Japan, and the other from Manilla to China. It was anticipated that these cables would be working last April. The cost for telegrams from Honolulu to San Francisco is 35 cents per word, and to Paris 72 cents per word.

Each of the large islands of the archipelago possesses its own telephone system, but the most important company is naturally that of Oahu, with headquarters at Honolulu. Founded in 1880, it absorbed a rival enterprise in 1890, and since then has held a monopoly; it possesses to-day a length of wire of 2,000 miles, and has 1,500 subscribers using telephones on the Bell system, which are loaned by the company in the town at rates of $4 per month for shops and offices and $2.50 for private residences, and in the country at a rate of $7.7 per month. The farthest telephone from the central exchange is 32 miles distant; the exchange makes on an average 9,300 connections per day. The service leaves much to be desired, and a rival company, the Standard, is preparing to give the town the benefits to be derived from competition.

India.—The Baudot system of telegraphy was tried between Madras and Bombay on July 7th, and most successful results were obtained.—*Indian Engineering.*

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Cayenne-Pinheiro	Aug. 18, 1902	
Port Arthur-Chifu (Closed)	Mar. 7, 1904	
Tarifa-Tangier	Jan. 18, 1904	
Garachico (Tenerif)-Santa Cruz	July 12, 1906	
Bolamo-Bissao	July 24, 1906	
Curacao-La Guayra / Curacao-Coro (Closed)	Jan. 11, 1906	
Landlines.		
Puerto-Barrios	Aug. 28, 1902	
Bachkale-Deliman	Feb. 12, 1906	
Bagdad-Bassorah	July 17, 1906	

The World's Telephones.—The total number of telephone stations in four leading countries in 1905, according to *Elecktrotechnik und Maschinenbau*, was 2,830,000, America taking the lead with 1,800,000, contrasted with 135,000 in 1885; Germany second, with 550,000 against 16,000; England, 350,000 against 15,000; and France, 130,000 against 7,000. America's development is especially noteworthy, she having, in 1885, when the telephone had hardly received practical adoption in Europe, so many as 135,000 in use. Progress in the other European countries has

been much slower, as the following figures in the two periods show:—Sweden, 11,000 and 112,000; Russia, 5,000 and 54,000; Switzerland, 5,000 and 53,000; Austria, 4,000 and 47,000; Italy, 2,000 and 25,000; Hungary, 1,000 and 25,000, and Belgium, 3,000 and 25,000.

Wireless Telegraphy.—It is expected that the large installation of wireless telegraphy, which the German Post Office authorities have established at Norddeich for post office purposes, and for the use of the mercantile marine and the Navy, will be fully set in operation in October. The torpedo boat, "S 36," recently proceeded to sea for the purpose of making experiments in conjunction with the Norddeich station, and these are reported to have been thoroughly satisfactory. At present the service at this coast station is rendered by three officials who were formerly engaged at the Emden telegraph office, and who underwent a special course of instruction at Berlin during last winter. The station is 200 ft. high, and is formed of four iron towers arranged on an iron base insulated by means of an oak foundation. At the height of 154 ft., the towers are brought to "flat points" upon which the receiving network is arranged, and the actual station itself is built underneath between the towers. At present there are 13 "telefunken" stations on the German coast, three being in the Baltic, and 10 on the North Sea coast, while several smaller stations are in course of establishment. The total number of coast and land stations in Germany is 27, which are said to be effective at distances ranging from 62 miles to 620 miles. The aggregate for this particular system is reported to be represented by 300 stations on warships and merchant vessels of Germany, the United States, Holland, Brazil, Argentina, Denmark, Sweden and Norway, and 123 stations on land and the sea coast.

CONTRACTS OPEN and CLOSED.

OPEN.

Belgium.—La Société du Canal et des Installations Maritimes de Bruxelles (59, Rue du Canal, Brussels) is inviting tenders until August 24th for the supply and erection of electric lifting and hoisting plant at the new Entrepot Public in Brussels.

Dudley.—August 13th. Feeder and distributor cables for the Electricity Department. See "Official Notices" July 27th.

Germany.—Tenders are about to be invited for the extension of the electric lighting station at Viersen (Rheinland), at an estimated cost of £9,250.

Handsworth.—September 15th. Electric wiring for the Council's new schools. See "Official Notices" to-day.

Leeds.—August 15th. Steam and other piping for the electricity department. See "Official Notices" July 20th.

Lurgan.—August 17th. The T.C. wants tenders for telephone line, water-level recorder and transmitting apparatus. Consulting engineer, Mr. H. Harris, 30, Parliament Street, Dublin.

Spain.—The municipal authorities of Alberique (province of Valencia) have just invited tenders for the concession for the electric lighting of the town during a period of five years.

Stockport.—August 11th. Water-tube boiler, superheater and stoker, for the electricity works. See "Official Notices" July 27th.

Weston-super-Mare.—August 22nd. The Electric Supply Co. wants tenders for cables, joint boxes, feeder pillars, &c. See "Official Notices" to-day.

CLOSED.

Bexley.—The U.D.C. has accepted the tender of Messrs. Measures Bros., Ltd., for steelwork for the car-shed extensions, at £289 17s. 11d.

Bristol.—The T.C. has accepted the following tenders:—

Mr. H. Tuchman, arc lamp carbons	£362	3	3
Richard Woods & Co., A.C. motors, &c.	134	9	0
Morris-Hawkins Electrical Co., Ltd., D.C. motors, &c. ..	496	12	0
E. Brook, Ltd., A.C. motors, &c.	139	10	0

Chipping Norton.—The T.C. has accepted the tender of Messrs. H. Bunting & Son, of Chipping Norton, for the conversion of the street lamps from gas to electricity.

Canterbury.—The T.C. has accepted the tender of Mr. E. J. Philpot, electrical engineer, of Canterbury, for electrical illuminations at the Corn Exchange, Guildhall, and the Beaney Institute during the cricket week, at £40.

France.—The French Post and Telegraph authorities in Paris have given out contracts as follows:—La Compagnie Française des Métaux, Paris, 48 tons of bronze wire, $1\frac{1}{10}$ mm. diameter, at 3,346½ fr. per ton; 102 tons of copper wire, 4 mm. diameter, at 2,646 fr.; 103 tons ditto, at 2,647 fr. Les Trefileries du Havre, 47 tons bronze wire, $1\frac{1}{10}$ mm. diameter, at 3,330 fr. per ton; 55 tons ditto, 15 mm. diameter, at 3,390 fr.; 155 tons of copper wire, 2 mm. diameter, at 2,645 fr.; 112 tons ditto, 2½ mm. diameter, at 2,640 fr.; 115 tons ditto, at 2,645 fr.; 193 tons ditto, 4 mm. diameter, at 2,639 fr. La Société des Mines de Pontgibaud, 110 tons ditto, 2½ mm. diameter, at 2,629 fr. M. Grammont, of Pont de Cheruy, 118 tons ditto, at 2,634 fr.; 95 tons ditto, 5 mm. diameter, at 2,632½ fr., La Compagnie Générale d'Electricité, Paris, 120 tons ditto, 2½ mm. diameter, at 2,640 fr.; 30 tons ditto, 1 mm. diameter, at 2,640 fr.; 40 tons ditto, 2 mm. diameter, at 2,640 fr.; 120 tons ditto, 5 mm. diameter, at 2,640 fr. La Société des Forges de Franche-Comté, of Besançon, 89 tons copper wire, 3 mm. diameter, at 2,638 fr. per ton. La Société d'Electro-Métallurgique de Dives, Paris, 91 tons ditto, at 2,630 fr. La Compagnie Française du Bimetal, Paris, 105 tons ditto, 5 mm. diameter, at 2,630 fr.

Gloucester.—The Education Committee has accepted the tender of Messrs. Mitchell & Co., of Gloucester, for installing the E.L. and electric bells at Derby Road Schools, at £303 14s. 3d.

Indian Military Works.—Tenders were recently invited for the supply and erection of a complete electric installation for the Lucknow Cantonments. Ten estimates were opened, and the military authorities divided the contract between three Indian firms whose tenders were lowest, namely (1) Messrs. Steele & Co., aerial wiring; (2) Messrs. John King & Co., shipbuilders, wiring of barracks for lights and fans; (3) Messrs. Schroeder, Smidt & Co., engine-room equipment, this firm being agents for German machines.

Kingston-on-Thames.—The T.C. has accepted the tender of Messrs. W. Cory & Son, Ltd., at 10s. 11d. per ton, for the annual supply of coal to the electric lighting undertaking.

Leek.—The U.D.C. has accepted the tender of Messrs. Jas. Heath & Sons, for foundations for a new engine and dynamo at the electricity works, at £113 12s. 5d.

Leith.—The Hart Accumulator Co., Ltd., have secured the contract from the Corporation for renewing the existing storage battery at the electricity works, with 256 of their standard central-station type cells.

London.—Metropolitan Asylums Board.—The Board has received the following tenders for wiring, &c., Downs School for electric lighting:—

Dargue, Griffiths & Co.	(accepted)	£2,407
Thos. Hiscock		2,469
Thos. Potter & Sons		2,493
Bromley, Batstone & Kirk		2,499
Smeeton & Page		2,545
Lund Bros. & Co.		2,550
Tamplin & Makowski		2,555
Coleby & Co.		2,626
Mann, Egerton & Co.		2,643
John Barker & Co.		2,646
Cowtan & Sons		2,650
Robert Cort & Son		2,651
L. Sunderland & Co.		2,655
Sweet Bros.		2,673
Frank Suter & Co.		2,791
Army & Navy Auxiliary Co-operative Supply ..		2,885
Electrical Engineering and Maintenance Co. ..		2,892
Western Engineering Co.		2,935
Buchanan & Curwen		2,950
F. A. Glover & Co.		2,958
Warren, Smith & Co.		2,994
Eastlakes, Ltd.		3,365
Jackson Bros.		3,523
Ward, Barker & Co.		3,650
E. P. Allam & Co.		3,986

The engineer-in-chief's estimate was £2,600.

Middlesex.—The C.C. has accepted the tender of Messrs. Dick, Kerr & Co. for the construction of the electric tramway lines from Wood Green, through Palmer's Green, to a point in the Green Lanes at Enfield, at £65,910.

Reading.—The T.C. has accepted the tender of Messrs. Gent & Co. for an electric water-level indicating apparatus, at £39.

Stockport.—The T.C. has accepted the tender of Messrs. T. & W. Meadows, of Stockport, for car-shed extensions, at £1,722.

Stockton and Thornaby.—The contract for electric lighting and power at the Stockton and Thornaby Surgical Hospital has been placed in the hands of Messrs. T. B. Watson & Son, Central Electrical Works, Stockton-on-Tees, who will carry out the installation to designs and specifications prepared by Mr. Cecil E. Lugard, A.M.I.E.E., Middlesbrough.

Surrey.—The C.C. has accepted the tender of Messrs. H. J. Cash & Co., of London, for installing the E.L. at the Netherne Asylum, at £9,740.

NOTES.

Tramway Brake Tests.—According to a correspondent, the Halifax Corporation have recently made some tests to determine the efficacy of tramway brakes, this following on the serious accident which occurred on the North Bridge on July 1st. The car in question has been subjected to tests by Mr. John Waugh, C.E., of Bradford, whose report was received a few days ago. The first tests, Mr. Waugh says, were made with the rheostatic electric brake on a portion of the Hebden Bridge route, where there is a gradient of 1 in 11. By the application of the electric brake, the car was stopped in four seconds, and within a distance of 16 yd., when travelling at the rate of 16 miles an hour; and when travelling at 22 miles an hour, it was brought to a stand in nine seconds and within 57 yd. 2 ft. By the reversal of the current the car was stopped on the same gradient in 10 seconds, and within a distance of 58 yd. 2 ft., when going at the rate of 21 miles an hour. The car was afterwards driven over the Savile Park section, where there is a straight run of from 500 to 600 yd. By the application of the electric brake, the car was stopped on a gradient of 1 in 22 in 16 seconds; and within a distance of 120 yd., when going at the rate of 24 miles an hour. The next test was made on a portion of the same route where there is a gradient of 1 in 28. When the speed attained was 28 miles an hour, the electric brake was applied and the car brought to a standstill in 13 seconds and within a distance of 120 yd. Mr. Waugh adds: "The above tests show conclusively the potentiality of the electric brakes, and show that the car is equipped with the means of bringing it to a stand even when a high speed has been attained, without the aid of the other brake. In emergencies the slipper brake can also be used in conjunction with the electric brake; the conditions essential to success are: (1) The wheels of the car must not be locked by the use of the wheel brake. (2) A supply of sand must be available. The concluding test was made with the slipper brake, which consists of two blocks of wood applied to the rails about the centre of the car. The car was brought to a stand, the brakes being applied by the turning of the wheel at the back end of the car. When energy was switched on to the motors, the wheels revolved quickly, but the car did not move. This test showed that the pressure put on the rails was quite sufficient to keep the car stationary.

Our informant unfortunately does not mention the atmospheric conditions which prevailed during the test, nor yet the state of the rails, and consequently we are unable to judge the value of the results shown. Needless to add, almost any type of brake will give excellent results on dry or clean rails, as is well known.

Magnetic Observations in Berlin.—It would appear that the working of electric tramways on the overhead trolley system in the neighbourhood of Berlin, and of the recently opened electric haulage system on the Teltow canal, has brought about difficulties between the magnetic observatory and the town of Potsdam and the towing canal authority. As a consequence, the Meteorological Institute recently addressed a request to the Ministry for Home Affairs, asking for sanction to establish an auxiliary station for delicate magnetic registrations, while at the same time ameliorating the protective regulations for the principal institute at Potsdam. The proposal has now received the approval of the authorities, and preparations have been made in regard to the realisation of the scheme. It has been possible to secure a site eight miles to the south of the Potsdam Observatory, and on the northern bank of the Seddin Lake near Kunersdorf. The exact spot selected is in a wood, and the cost of the building and instruments is estimated at £2,200. In order that the work may be completed as rapidly as possible, and without waiting for an estimate to be inserted in the next Budget statement, the Teltow Canal Construction Board has advanced the necessary funds unconditionally. The explanation of this act is to be found in the fact that a moderation of the protective regulations of the Potsdam Observatory was largely in the interest of the Board in respect of the working of the electric system of canal boat haulage, and having obtained this concession, the Board has reciprocated in the manner mentioned.

I.E.E. in India.—Our Indian correspondent writes that although there is a fully officered section of the I.E.E. in Calcutta, no meetings have been held for at least three years. With the spread of electricity in India it is a pity that members of the electrical professon should be so lax, as many points of extreme interest to the electrical fraternity arise in a tropical climate, which could be discussed and cleared up at meetings. A reliable and efficient system of motor punkah pulling has yet to be found in spite of the many "best" systems in vogue—none of which give entire satisfaction.

Greenock Electricity Works.—Correction.—We regret that the view of the battery which was reproduced on p. 181 of our last issue was wrongly described; the battery in question was made by the Chloride Electrical Storage Co., Ltd., to whom our apologies are due.

An Attempt at Corruption.—Referring to the "Note" under this heading in our last issue, we are informed by Messrs. Preece & Cardew that the writer of the letter quoted, has since apologised, and stated that he will never write a similar letter again. May all such letters be treated in the same summary fashion as that adopted by Messrs. Preece & Cardew.

Beech Trees and Lightning.—The popular belief that beech trees are never struck by lightning would seem to be now exploded. Six men were sheltering under a beech tree in the Midlands during last week's severe storm; two were killed, and the others struck down insensible. At the inquest, the coroner said he had specially examined the tree, as for years he had read and understood that there was no record of a beech tree being struck by lighting. In this case the lightning had not injured the tree to the extent of damaging a leaf, but it was an accepted fact that six men were sheltering under a beech, and that two of them were killed whilst they stood there. He did not know whether there was anything in it or not, but it appeared to him to be a remarkable circumstance after what he had understood for so long, and he should record the fact that it was a beech tree in the verdict.

Motor-'Bus Progress.—From our esteemed contemporary, the *Daily News*, we cull the following item of interest to tramway men *apropos* of the report of the Cab and Omnibus Special Committee:—"Information is given of the extent of the motor-'bus traffic, which is almost startling. During the year ending June 9th, 1906, 521 motor-'buses were licensed by the Metropolitan Police, of which 18 were propelled by steam, and 503 by petrol. Only 52 motor hackney carriages, all petrol-driven, have been licensed, but a large number are being constructed, and will shortly be placed upon the streets."

Our contemporary then quotes the report as follows:—"We believe that as many as 25 per cent. of these omnibuses are in garage undergoing adjustment or repair on any one day. The average daily mileage of each vehicle is from 100 to 120 miles; with 75 per cent. of them running, therefore, the average total daily mileage is about 47,000 miles. That is, in spite of the infancy of this traffic, and the present high percentage of disabled vehicles, the total mileage per annum of motor-omnibuses in the metropolis is already nearly 17,000,000 miles." The quotation from the report is undoubtedly startling, more so than our contemporary's preliminary remarks.

Annual Outing.—On Saturday the burgh of Motherwell electricity works had their annual outing to the Falls of Clyde, Lanark. The party drove to Lanark in brakes, and spent an enjoyable day inspecting the Falls and various places of interest in the neighbourhood.

A Spider Story.—According to a correspondent of the *Daily Mail*, a policeman searching for burglars in a shop recently found that the electric bell, which first attracted his attention to the premises, had been set ringing by a spider. This intelligent creature had wound its web from the bell to the battery in such a way as to cause the bell to ring. Whether it liked the sound, or whether it hoped to attract flies thereby, is not stated, nor is it explained how the feat was accomplished.

A Birmingham Charge.—It will be remembered that when the charge against F. J. Clarke, electrical engineer, of having stolen brass and copper scrap from Messrs. W. Canning & Co. (for whose electrical engineering department he was manager) came before the Birmingham Courts last April, the jury disagreed. The case was again heard last week at Birmingham, when the jury found him guilty, but recommended him to mercy on the ground of his previous good character, and of this being his first offence. He was bound over in the sum of £50 to come up for judgment when called upon.

Cooper's Hill.—On the 26th ult. the final celebration of "Prize day" took place at the Royal Indian Engineering College, Cooper's Hill. Mr. St. J. Brodrick performed the ceremony and addressed the students. During its thirty-five years' existence the college has supplied 979 men to the Indian Services, of whom 84 were appointed assistant superintendents in the Telegraph Department.

Milan Exhibition.—A grave disaster took place on Friday last, when the Italian and Hungarian Decorative Art sections of the Exhibition were completely destroyed by fire; the English Art section fortunately escaped.

Canal Commission.—Last week the Royal Commission on Canals and Waterways continued its sittings, dealing with the canal system in Wiltshire, Hants and Berks. A scheme was put forward by Mr. A. C. Williams, acting conservator of the River Dee, for restoring the communication between Chester and the sea, and Mr. C. A. Stevenson, of Edinburgh, also dealt with this subject.

Gas Fatalities.—A serious gas explosion took place in Holborn last week, killing a gas fitter, severely injuring his two mates, as well as a woman and two children, and killing three horses. A building was wrecked.

A man named Arthur Cordrai was suffocated by gas on the 27th ult.; the telescopic gas fitting in his bedroom had run short of water, allowing the gas to escape.

A violent explosion, followed by a fire, was caused at Croydon last week by the lighting of a fire while the gas was escaping. The windows were blown out and four persons were badly injured.

Lancashire Electric Power Bill.—On 1st inst. the Lords' amendments to this Bill were agreed to by the House of Commons.

(Continued on page 224.)

THE MOUTIERS-LYONS HIGH TENSION DIRECT-CURRENT TRANSMISSION.

The recent consideration of Mons. Thury's system for the Zambesi power transmission scheme, the purchase of his English patents by one of the leading manufacturing firms, and the belief that in this latest system he would make many improvements on his previous work, should cause great interest to be taken in the new transmission system from Moutiers, in Savoy, to the city of Lyons, in France, a total distance of 180 km., with a maximum direct-current pressure of 60,000 volts. The district lying to the east of Lyons contains many water-power stations, and the new power supply consists of an interesting combination of three-phase alternating current and high-tension continuous current.

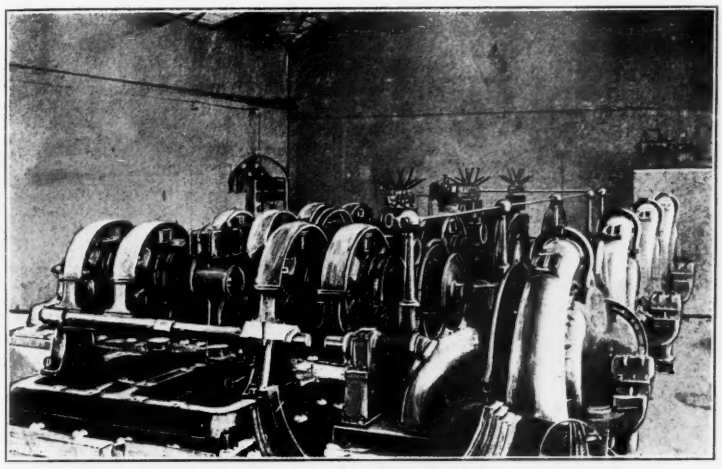


Fig. 1.—Interior of the Moutiers Generating Station.

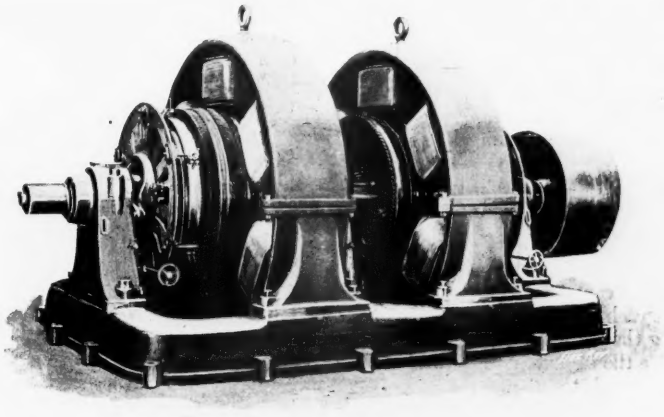


Fig. 2.—A Moutiers Semi-generating Unit in the Factory.

The generating station at Moutiers transmits energy 140 km. to a switch house at Sablonnières, which also forms the centre of a converging three-phase system of transmission lines bringing energy from Bellegarde (10,000 H.P.), Avignonet (8,000 H.P.), Lechylienne (8,000 H.P. new station), and La Bourne (5,000 H.P.), see map, fig. 5, the whole system being under the control of the Société Grenobloise de Force et Lumière. All these plants supply energy at 26,000 volts pressure 50 cycles three-phase, with delta connected transformers at the receiving end.

From Sablonnières the total energy is transmitted 40 km. to Vaulx-en-Velin by two sets of three-phase lines (six in all) and two direct-current lines, the total power required for Lyons being then transmitted 4½ km. underground into a receiving station at the Rue d'Alsace: it is there transformed into direct current at 600 volts pressure for the traction system, by three-unit motor-generator sets, each consisting of two high tension Thury motors direct coupled through a flexible insulated coupling to a traction generator.

The arrangement of the apparatus in the Moutiers station is very clearly shown by the general view, fig. 1, from which it will be seen that four Thury groups are provided, each driven by a separate water turbine: each group consists of four armatures and four magnet frames in two pairs, each pair mounted on a common cast-iron base and separated from the other pair by an insulated friction coupling, the whole group being then coupled to the turbine through another similar coupling — an ar-

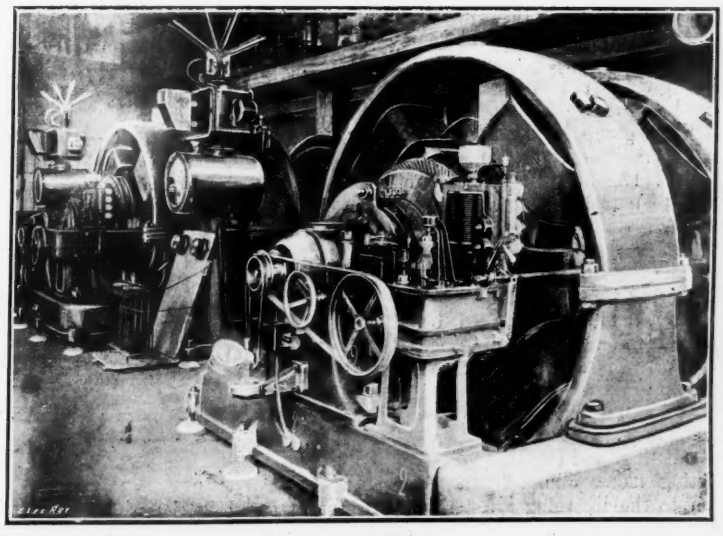


Fig. 3.—Interior of the Vaulx-en-Velin Generating Station.

rangement which is very clearly shown. This figure also shows the method of insulating the bases of the machines

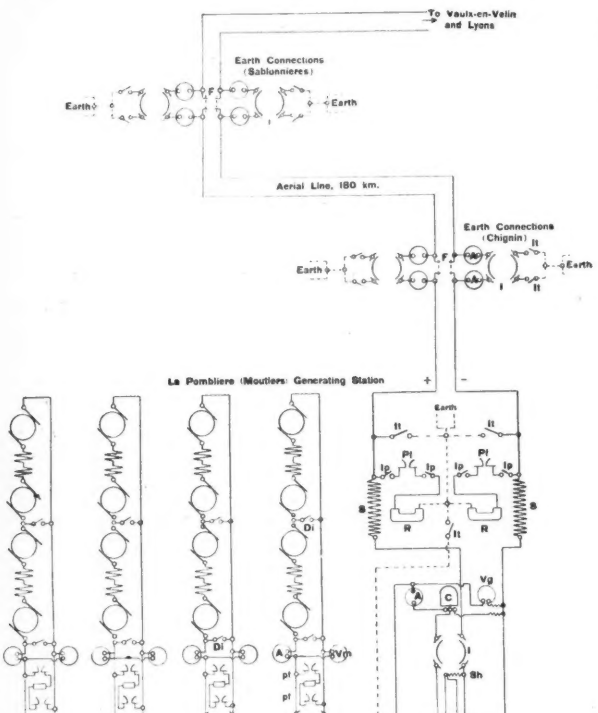


Fig. 4.—Diagram of Electrical Connections of the Thury System.

by bolts which fit into the inside of double cup insulators embedded in the usual insulated foundation.

Each group has one ammeter, one voltmeter, a switch and a pair of horn lightning arresters with resistance arranged in the manner shown in the general scheme (fig. 4) and all mounted in the small controlling pillars which stand beside each group.

The object of arranging the generators in this way is to overcome the objection raised previously, with regard to the difficulty of increasing the capacity of a Thury system without raising the pressure, and thus making it necessary to purchase a completely new equipment of line insulators, since the two units on one bedplate and the same shaft may be placed in parallel, thus doubling the current on the line and the additional apparatus to be purchased, placed in series for giving the necessary increased capacity.

Each group in the Moutiers station has a maximum pressure of approximately 15,000 volts (3,300 per commutator), and the line current is 75 amperes, thus giving a total output from the station of approximately 4,500 kw.

The turbines are of the reaction type, operating under a water head of 65·5 metres, and were supplied by Messrs. Piccard, Pictet & Cie., of Geneva.

Energy is delivered from the generators to the switchboard in the positive side of the line, passing through the ammeter, recording wattmeter and main regulating switch, through the regulating motor and solenoid, and then on to the lightning arrester compartment arranged in the manner indicated, which will be referred to later.

It will be noticed that provision is made for grounding the centre point of the system, and also either line, in case of breakdown.

On leaving the station, the line passes to the first earthing station at Chignin, where the section between Chignin and Moutiers, or Chignin and the second earthing station at Sablonnieres, may be grounded. The cabin at Chignin contains only two switchboards, both duplicates, the exact arrangement being shown in fig. 7.

The Sablonnieres cabin is situated approximately 40 kilometres from the Vaulx-en-Velin station, and contains in

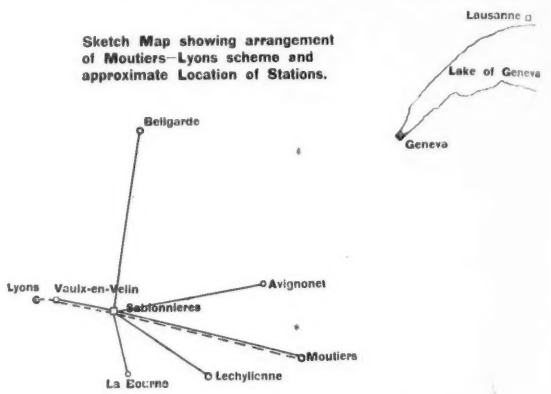


Fig. 5.—Plan of Moutiers-Lyons Electrical Transmission.

addition some switching gear for disconnecting, in case of necessity, the three-phase lines which converge at that point.

The idea is to operate this system with the centre point earthed and the two lines insulated, so that in case of accident, or if it is necessary to replace the insulators, &c., on either the positive or negative, that line may be grounded, and the earth used for transmission.

It will be noticed that the equipment at both these earthing stations for the direct-current system contains four ammeters: this enables observations to be taken of the current passing either into or out of the cabin, and by the earth or by the wire. The earth connections at these cabins simply consist of iron plates, scattered over a small area, and buried wherever possible in wet earth.

Fig. 6.—Switch Tower as used in the Moutiers Station.

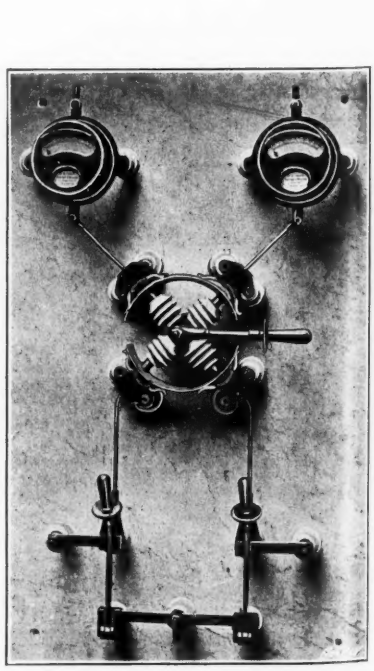


Fig. 7.—Earthing Switchboard used at Sablonnieres and Chignin.

Mons. Thury claims that there is never more than a maximum of 200 volts drop between ground and line, when carrying the full current of 75 amperes.

At Vaulx-en-Velin the line enters through lightning arrester arrangements similar to those employed at Moutiers, but containing also a discharge gap and resistance for shunting the horn arresters. Two condensers of one-tenth microfarad capacity are already ordered, and will be connected on the inside of the other lightning protections. The inductive coils are ten in number, each one having 40 turns. Each of the condensers will have one terminal connected to earth, and the other to the positive and negative lines respectively. Two condensers are also stated to be on order for the Moutiers station, where they will be placed in a similar electrical position.

Below the lightning arrester chamber are situated the ammeters and voltmeters respectively for the positive and negative lines and the regular earthing switches, the voltmeters both having one terminal connected to earth.

At the Vaulx-en-Velin station three groups are provided, each consisting of two Thury machines connected by an insulated flexible coupling to a three-phase alternating-current machine, the Thury machines being mounted on a common bedplate insulated from the earth in the usual manner (see fig. 3).

Machines with the regulator switch tower, &c., are also shown in fig. 3. Each set has a capacity of 800 H.P. with a maximum pressure of about 7,800 volts across each direct-current group. The alternating-current machines, which were made by Messrs. Schneider & Co., of Champagne sur Seine, are wound for 11,000 volts, 50 cycles, three-phase, the sets operating at a speed of 428 r.p.m. The alternating voltage is stepped up or down by transformers, which are at present connected for 26,000 volts.

The greater part of the A.C. power obtained is distributed three-phase through step-down transformers to factories, which are thickly scattered over the district, this being the reason for using both three-phase alternating and D.C. transmission lines between Sablonnières and Vaulx-en-Velin, since the direct current offers advantages in transmission, but does not at present offer such facilities as a three-phase line for factory supply. All transformers, switches, line insulators, &c., on the alternating-current system are stated to be installed for 40,000 volts, since it is anticipated that it will shortly be necessary to change the whole three-phase system to that

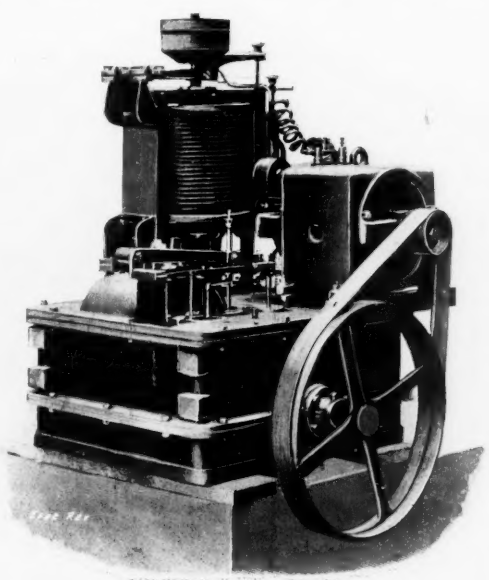


Fig. 8.—Constant Speed Regulator for Thury Motors in the Rue d'Alsace Station, Lyons.

pressure by adopting new transformers, changing those already installed from "delta" to "star" connection, and rebuilding some of the old transmission plants mentioned above.

The function of the Vaulx-en-Velin station is somewhat complicated. It forms a final receiving point for all the power transmitted towards Lyons, and acts also as a reserve station, so that in case of breakdown at Moutiers or on the transmission line from Moutiers, the A.C. machines at Vaulx-en-Velin may be driven as synchronous motors operating the

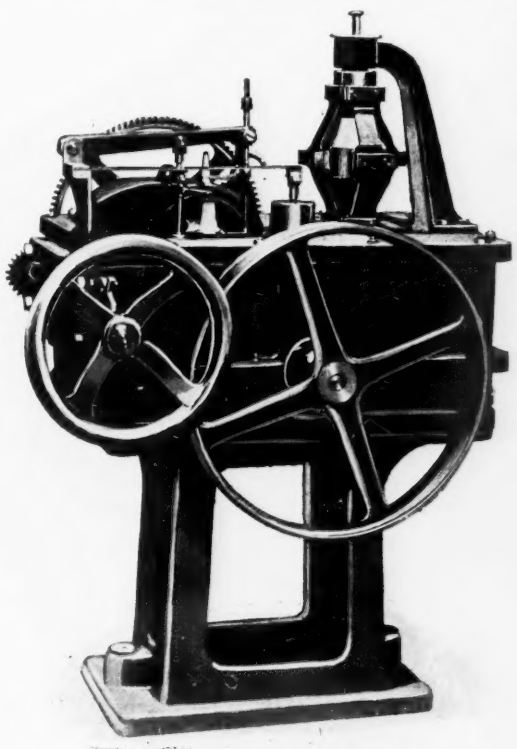


Fig. 9.—Regulator for Controlling the Moutiers Generating Station.

Thury machines as generators to supply Lyons, and in case additional three-phase energy is needed, the Thury machines may also be operated as motors, driving the A.C. machines as generators.

The Vaulx-en-Velin station also contains two special 600-volt 47-ampere shunt-wound generators, each driven by an induction motor mounted on the same bed-plate, all these machines being used as exciters for the three-phase machines, and also to start the Thury machines as motors, in case of a breakdown at Moutiers occurring while none of the machines in Vaulx-en-Velin are operating.

From Vaulx-en-Velin energy is supplied to Lyons through underground cables to the receiving station at the Rue d'Alsace, where it will be transformed for transmission purposes by five groups, four of which are installed.

This station has no exceptional arrangement, the groups being placed in a row down the station, separated from one another by a space containing the switch tower. Each group is surrounded by insulated flooring, about 6 ft. wide.

Fig. 2 shows one of the semi-groups for the Moutiers station. The machines here shown mounted together on one bed-plate have a rating of 75 amperes, and when connected in series have a maximum voltage of 7,800 at 300 r.p.m.

These machines show a standard round type of frame, Mons. Thury having now discarded his old type of built-up frame for reasons of economy.

The Insulation of the System.—In all the stations of this system, Mons. Thury employs his old method of insulating all the machinery in the station from the earth by means of an insulated flooring, which consists of an upper layer of pure asphalt approximately 1 cm. thick; next, a layer of asphalt and small stones about 1½ cm. thick; and finally, the concrete foundation. It is stated that this flooring will withstand 80,000 volts (alternating).

The machine bedplates are supported by double cup insulators which fit into a foundation about 6 in. above the surface of the flooring, the space between the two insulators and the space surrounding the bolt being filled up with litharge.

The cables throughout the station are laid in terra-cotta ducts set in concrete. The type of switch tower used is clearly shown in fig. 6. It contains the regular short-

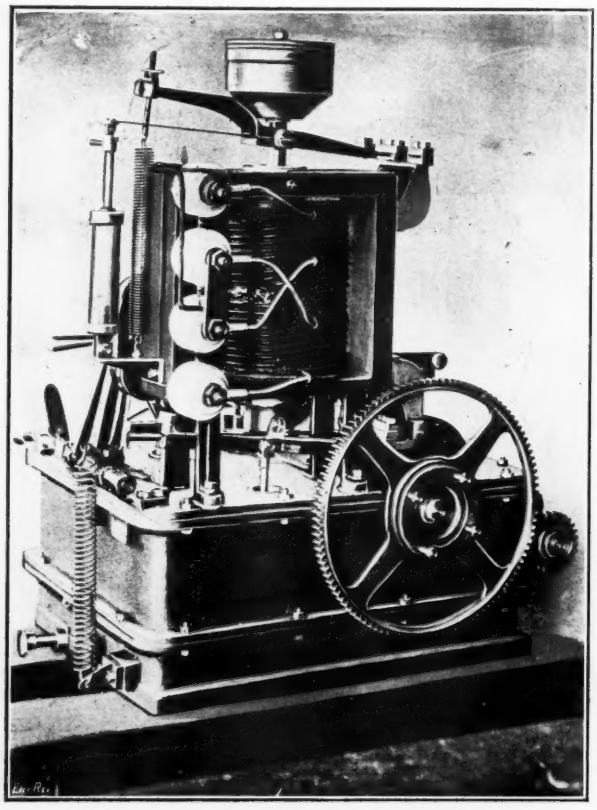


Fig. 10.—Regulator at Vaulx-en-Velin.

circuiting switch employed in previous installations, the function of which is shown by the general scheme (fig. 4) and the ammeter and voltmeter mounted as shown on each side of a casing which contains the voltmeter resistance. The horn arresters mounted on the top are of the regular pattern, the prongs above forming the magnetic blow-out. The method of insulating the switch handle with four insulators is also clearly shown. At the back of the casing containing the voltmeter resistance there is mounted in the Lyons station an automatic switch, which short-circuits the motor if the voltage becomes too high.

In fig. 3, showing the interior of the Vaulx-en-Velin station, will also be seen the method of mounting the tachometer on the bearings standard; the small box shown between the tachometer bracket and the shaft contains an automatic short-circuiting cut-out, in case a machine operating as a generator should slow down and tend to reverse as a motor without warning.

Lightning arresters are provided on the tops of the switch towers in the Lyons station, but it is said to be Mons. Thury's intention to remove these, as no trouble is being experienced.

The cables used for the underground transmission are stated to be normally designed for a pressure of 25,000 volts alternating. They were manufactured by Messrs. Berthoud and Borel, of Lyons, and are spoken of as 50,000-volt continuous-current cables. They consist of 19 strands, with a sectional area of 75 sq. mm., the diameter being 6 cm. over all, and the insulating material consists of paper, covered with two lead and two steel armour sheaths. Tests were made on this cable with 70,000-volt continuous current on a 100-metre length; no current reading whatever was obtained on an ammeter with a total scale of $\frac{2}{10000}$th of an ampere. The cables were also tested with an alternating pressure of 60,000 volts for 15 minutes.

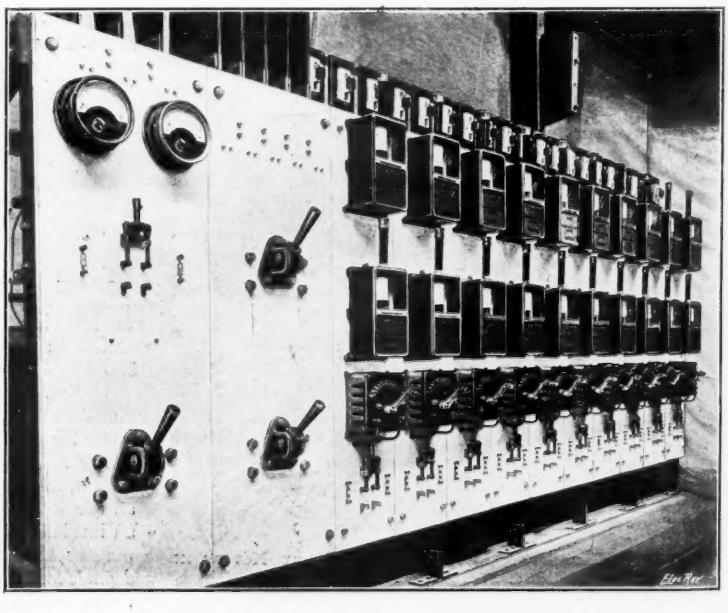
The line insulators, which were manufactured by the Karlsbader Kaolin Industrie Gesellschaft, are made of porcelain in three sections, the height over all being 21 cm., and the respective diameters of the sections 22, 11 and $6\frac{1}{2}$ cm. respectively. Throughout the whole system numerous short-circuiting switches are provided for cutting out any portion of the system while repairs are being made.

Regulators.—The regulators employed on this system offer many points of exceptional interest. At Moutiers the regulator (fig. 9) is very similar to the one used at St. Maurice (the power station for the Commune de Lausanne system). The governor operates to maintain a constant current of 75 amperes by means of a solenoid in series with the line, the current strength varying the position of the armature, the motion of which is transmitted through a system of ratchets and toothed wheels to the governor shafting; the ratchets are kept in motion by a small motor in series with the line, having carbon brushes and absorbing about 6 volts, whereas at St. Maurice it has copper brushes and absorbs about 3 volts.

The full current does not pass through the motor, since it is shunted by a permanent resistance (see fig. 4). A three-cell secondary battery is also placed across the motor to keep it operating in case of interruption of the circuit. This apparatus is neatly mounted on a small pillar of approximately the same dimensions as the switch towers. The governor shafting just referred to operates hydraulic pilot valves, which in turn work the main turbine gates. The regulator acts simultaneously on all the machines when running, and ample emergency levers for hand control are provided.

At Lyons the regular centrifugal ball type of governor is employed (fig. 8), which serves to hold the speed constant by varying the position of the brushes over the voltage angle in accordance with the torque demanded by the railway generator.

At Vaulx-en-Velin a most ingenious combination of both the above regulators is employed (see fig. 10 and fig. 3), since, as above stated, the Thury machines must act either as motors or as generators; the regulator therefore simply consists of the essentials of both the above regulators, either of which can be arranged to operate on the same brush-shifting gear. All the working parts of these regulators are



Port Louis, Mauritius: Sub-station Switchboard.

contained in the cast-iron casing shown, which is kept full of oil. An automatic open circuit switch is provided to short-circuit the generator, in case of interruption of the line. The small motor used at Moutiers is, of course, unnecessary here, and the ratchets can be operated by belting direct from the generator shaft.

In conclusion, it should be stated that in this necessarily brief description many points of interest must be overlooked, but those who have the opportunity of visiting this system will be much impressed by the skill and ingenuity which have overcome all the obstacles recently spoken of as being detrimental to the system.

Those who have had trouble from lightning, either static or dynamic, should especially note Mons. Thury's arrangement of placing a condenser inside all the other usual protective devices, this having the effect of absorbing any abnormal peak of voltage which may pass through the other arresters. It is interesting, also, to note that Mons. Thury claims exceptional freedom from lightning trouble.

ELECTRIC LIGHTING AT PORT LOUIS, MAURITIUS.

The town of Port Louis, Mauritius, will be lighted by 1,000 16-c.p. lamps, fixed on suitable brackets in the streets, the energy being obtained from a hydro-electric power station situated about four miles from the town.

In the station is installed a turbine of Messrs. Gilbert Gilkes's make, of the twin type, operating under a 66-ft. head, and capable of developing 103 b.h.p., with a speed of 500 r.p.m.; it is fitted with a sensitive governor for controlling the speed.

The turbine is coupled direct to a single-phase alternator designed for an output of 75 k.v.a. at 5,000 volts pressure, with a direct-current exciter in addition, the latter being large enough for supplying energy for excitation purposes, as well as for lighting the station and thus obviating the use of a local transformer.

The switchgear consists of polished marble panels containing ammeter, voltmeter, high-tension oil circuit breaker, shunt regulator, main field regulator, &c., and two double-pole switches and fuses, one for lighting, the other for the excitation circuit of the alternator.

The high tension carrying portions of the apparatus are arranged at the back of the board, all instruments and apparatus on the front of the board being at low pressure. An overhead pole line connects the generating station with a sub-station in the town.

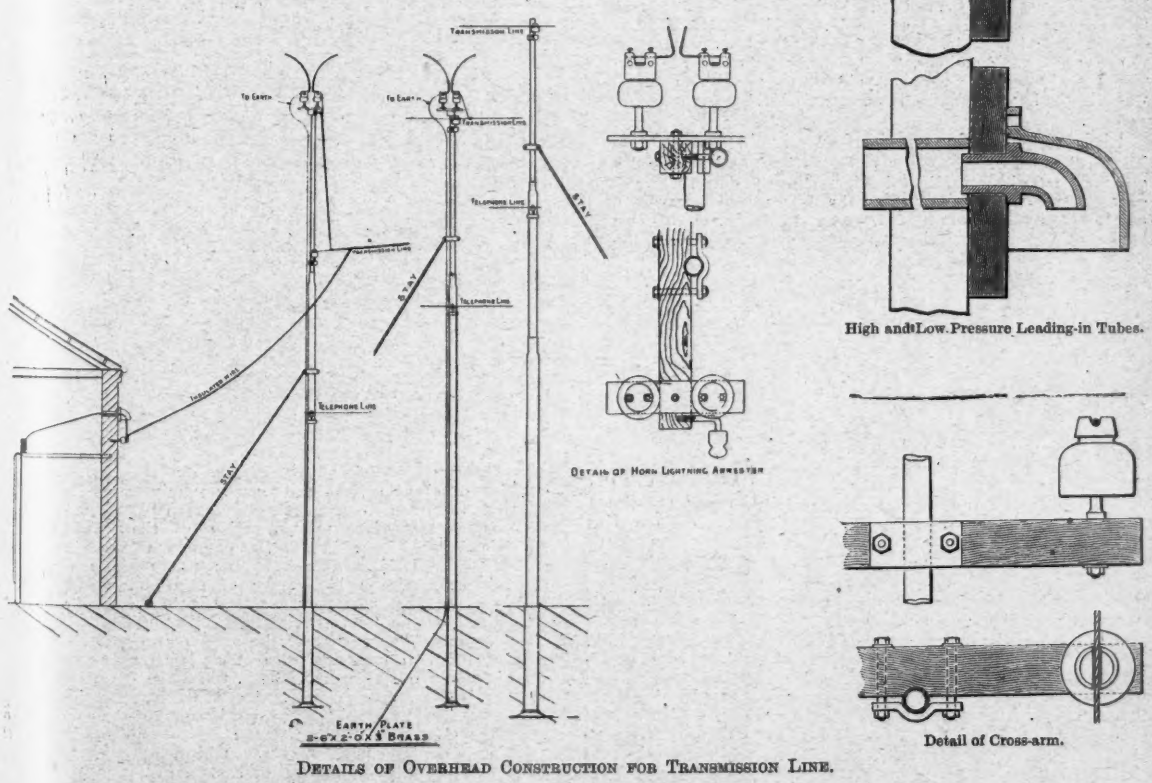
The connection both at the generating and sub-station to the transmission line consists of heavily insulated cable, fixed on insulators, and entering the buildings through special leading-in tubes.

Lightning arresters are provided at the ends of the transmission line as well as at two points on the route. These lightning arresters are of the horn type, provided with suitable choking coils, and on the route are fixed on special brackets on the poles themselves.

The transmission line consists of No. 10 S.W.G. bare hard-drawn copper wire, fixed on triple petticoated insulators. The latter are mounted on the oak cross-arms of steel masts which are spaced about 40 to the mile.

From the point where the high-tension mains enter the town to the sub-station, a distance of about ¾ mile, heavily-insulated aerial cable is supplied, supported from steel cable by means of raw-hide clips. Telephone communication is also provided between the generating and sub-station, the telephone wires being attached to the same posts as the transmission line and crossed over at intervals to avoid induction.

At the sub-station the high-tension transmission lines end at the main switchboard, arranged for both high and low tension, as shown in our view, the line terminating at the end panel, which carries an ammeter and voltmeter for measuring the total input of the station, also a high-tension oil circuit-breaker.



Details of Overhead Construction for Transmission Line.

The second panel contains two double-pole high-tension oil-break switches. Energy is taken from these panels to two 40-KW. oil-cooled transformers, from the L.T. side of which connections are taken to either side of double-pole change-over switches shown on the distribution panels, so that any circuit can be worked off either transformer.

The lighting of the town is divided up into 10 circuits; so as to compensate for the pressure drop in the various lines, regulators have been provided to regulate the pressure in the different circuits. Each circuit is also provided with a recording ammeter and voltmeter.

The L.T. mains are of bare copper of various sizes, run overhead and fixed on to suitable insulators; each of the 10 circuits is provided with lightning arresters, fixed above the board as shown.

The equipment has been put down by Messrs. Johnson and Phillips, Ltd., Victoria Works, Old Charlton, Kent, and with slight exception, all the electrical apparatus has been made at their works.

NOTES.

(*Concluded from page* 218.)

Electric Shock Fatality.—According to a Glasgow paper, a man named Bozlan, a foreman labourer employed by the British Westinghouse Co. at Clyde Valley Electric Power Station, was killed, while erecting a scaffold, by his hand coming into contact with a live cable. It is stated that the body was attached to the wire for half an hour, "it being about that time before the power was turned off, and anyone able to get near him, and ere he was released he was practically unrecognisable."

Lightning Incidents.—Truly we live in electrical times. The great storm of last week was noteworthy for the most brilliant and sustained display of lightning in and near London that we have ever witnessed; for nearly an hour the flashes were incessant, and at times the rain fell not in drops, but in spurts, as though the well-known effect of an electrical charge in converting a spray of water into a continuous jet were being manifested.

The telephone systems were slightly affected, several operators receiving shocks. No serious damage was done in London, a place which possesses a remarkably good record in this respect. At Guildford, however, some fatalities took place. A tramcar was struck on the trolley pole at Upton Park, the driver and conductor receiving slight shocks.

A correspondent writes:—The conclusions come to by Ashworth that the human breath possesses special conductive properties, from his observations that an electric spark from a Wimshurst machine had a greater length in breathed than in pure air, have been confirmed by M. Dufour. His conclusions are that the pulmonary and skin exhalations and the gassy emanations of the human body sensibly increase the loss of electricity from an isolated body and therefore ionise the atmosphere. Would this explain the tendency of a huddled-together flock of sheep or of cattle or horses sheltering under a tree to be struck by lightning?

London Smoke.—The Medical Officer of Health, in his annual report, gives a description of the generating station at Lot's Road of the Underground Electric Railways of London Co., Ltd., and proceeds to say: "The matter is of importance, as this generating station is probably the forerunner of many that will be established in London or its vicinity for the supply of electric current in bulk for motive power. The furnaces at Lot's Road are not designed for nor can they use Welsh or any form of hard smokeless steam coal. The heat generated by the use of such fuel would rapidly destroy the cast-iron chain grates. Consequently the company use a soft coal, which, unless burned with the aid of smoke-preventing appliances, as at Lot's Road, generates smoke in large quantities. Owing to the immense quantity of fuel required to run the works, coal is obtained from a variety of collieries, and as the quality of the coal from different pits varies, some descriptions being more suitable for the furnaces than others, it is probable that this fact to some extent accounts for the emission of black smoke at times from the chimneys. There is also the difficulty caused by the varying load, furnaces having to be kept banked in case of emergency; these have to be suddenly brought into action when required, necessarily generating much smoke, if quickly pressed to increase the head of steam. Although during the past year a great deal of black smoke, at times in dense volumes, has been emitted from the Lot's Road works, it seems probable that, with increasing experience, both as to the quality of coal best suited for the work, and as to the best methods of working the furnaces, that a fairly satisfactory result *qua* smoke will in time be attained, and that immense consumers of fuel such as these generating stations, will not materially add to the general smokiness of the air of London. By rendering unnecessary individual steam installations for generating power, they will, of course, diminish the amount of smoke from the chimneys of works of all kinds that is now an appreciable factor in the pollution of the atmosphere, not to mention the purification of the atmosphere of the underground Metropolitan and District Railways, which has already been effected."

In another part of his report the Medical Officer writes in reference to deposits of unconsumed cinder ash:—"As complaints continued to be received from the inhabitants of streets in the neighbourhood of the works of the Chelsea Electricity Supply Co., Ltd., the Borough Council, on the recommendation of the Public Health Committee, decided to take the opinion of counsel as to the powers possessed by the Borough Council for dealing with this class of nuisance. The opinion of counsel being favourable to action by the Borough Council if a sufficiently strong case of injury and nuisance to the inhabitants by the deposit of unconsumed cinder ash could be presented, the Public Health Committee caused the distribution among the complainants of sheets for recording the dates and other circumstances attending upon the deposits of ash upon their premises, which would guide the Committee in deciding upon the action to be taken in the matter. Since this course was adopted with a view to the gathering of evidence very few complaints have been received from the former complainants in the neighbourhood of the Chelsea Electricity Supply Co.'s works in Manor Street."

The Allen Institute.—At the invitation of the directors of Messrs. W. H. Allen, Son & Co., we visited the company's Queen's Engineering Works, at Bedford, on Friday last, on the occasion of the opening of the "Allen" Institute. The Institute has been provided by Mr. W. H. Allen, the chairman, for the use of the workmen employed by the company. Mr. Allen remarked that he hoped it would be for the welfare of the employés; that it would enable them to have their meals in comfort in future, and also provide a place for concerts and lectures.

After speaking on the merits of an institute where the men could be trained in the use of their leisure as in the use of their working hours, and begging them at the same time not to let it be a substitute for home life, Mr. E. R. Prothero, M.V.O., declared the institute open.

Mr. Reid, the works manager, on behalf of the employés, proposed a hearty vote of thanks to Mr. W. H. Allen for his gift, and took advantage of the occasion as a fitting opportunity to present to the chairman an illuminated address from the employés, thanking him for his generosity, and stating that the provision of the dining hall would add materially to the comfort of the men. The resolution was seconded by Mr. J. Smith, senior foreman, and carried with enthusiasm.

The Institute contains a dining hall, which will seat 280 people, and a library with 2,000 volumes, where newspapers and magazines are also available for the men's use. A room is set apart for chess, draughts and similar games, and beyond this is a smoking room, handsomely furnished. On the first floor is provided a billiard room, equipped with all that the heart of a billiard player could desire. The building was erected to the designs of Mr. Geo. Allen, son of the chairman. After the ceremony the visitors were conducted round the shops by Mr. Richard Allen, and a large amount of work was seen in course of manufacture. These works were fully illustrated and described in our issue of April 17th, 1903.

Electric Power in South African Mines.—The question of electric light and power supply on the Rand is referred to by a correspondent of the Berlin *Tageblatt*, who states that since the formation of the Rand Central Electric Works, Ltd., in 1895, the progress made has been comparatively small. As reasons for this position of affairs are cited, first, the high price of coal and railway rates, and, second, the monopoly enjoyed between Brakpan and Pardekraal by the Central Electric Works until after the war. The payment of 2½ per cent. of the gross receipts to the Government naturally caused the price of electric supply to be dearer than it would otherwise have been, while the expiration of the company's concession in 1909, when the right of expropriation exists, has also hampered the free development of the undertaking. After the conclusion of the war, the desire for centralisation of working in the large mine areas was facilitated by the preparation of plans for the establishment of central stations which would supply a group of mines. One station was started a few months ago to supply the new batteries of the Angelo and Cason mines. It will, however, be able largely to extend its sales, as it can obtain water from the Boksburg lake and coal from the Apex mines, and has at disposal the group of mines under Farrar control, as exemplified by the Driefontein, New Comet, Cinderella, Blue Sky, Boksburg and Hercules mines. A second large scheme is that of the Anglo-French Exploration Co., which would furnish with light and power the Benoni gold mines, the Apex mines, the Van Ryn Deep, the Kleinfontein Deep, the Chimes West and the Klipfontein mines. A third project relates to the plan of the General Mining and Finance Corporation to erect a central station on the Witpoort Farm, the eastern half of which belongs to the Rand collieries—a gold and coal mining enterprise under Albu control. It is proposed from this station to supply several of the associated mines, including the Cinderella Deep. A suspension of activity in regard to these schemes has, however, taken place for some time. In the first place, the Rand Central Electric Works Co., which the correspondent refers to as the Siemens group, has energetically bestirred itself recently. The maximum output of the station has been increased to 3,500 KW., the installation of turbine plant has cheapened the cost of working,

the Government has allowed the tax of 2½ per cent. to be altered so as to permit of the deduction being made from the net profits, and hopeful negotiations are proceeding for an extension of the company's concession under greater Government facilities for transmission and distribution of power. In addition to this, the company proposes to make a large extension and has dispatched Mr. Gorissen to South Africa to work out the scheme. It is with this proposal that the promoters of the Victoria Falls water-power works —the African Concessions (Options) Syndicate and its ally, the Allgemeine Elektricitäts Gesellschaft—will, in the first place, have to reckon. On the other hand, the Allgemeine Co. has in its plans an important argument to play by reason of its connection with the Dresden Bank and the General Mining Corporation. These plans are for the time being in abeyance, and the correspondent submits that there is, therefore, a prospect of the Zambesi project being carried out jointly by both groups, and on conditions which would abundantly assure the financial success of the undertaking from the sale of electrical energy to the mines alone.

Re Hawkes v. The Electrical Corporation, Ltd.—We have received, too late for insertion, a letter from Messrs. Hare and Co., solicitors to Mr. O. C. Hawkes, relating to this case. This letter will appear in our next issue.

Educational Notes.—The Board of Education has issued a memorandum on courses of work in rural evening schools, embodying some suggestions bearing upon technical instruction. The courses of instruction suggested are strongly utilitarian in character, but include also general educational matters, and show a most commendable desire to produce the kind of all round training likely to be most beneficial to the student.

King's College, London.—The session commences on October 3rd in Engineering and Applied Science. Prof. D. S. Capper is the Professor of Engineering; Prof. E. Wilson of Electrical Engineering. The college is part of the University of London, and provides both day and evening classes.

University of Glasgow.—The session commences on October 18th. Courses are provided for the degrees of B.Sc. and D.Sc. in engineering, and in the summer students usually receive practical training on the "sandwich" system. Professor of Engineering, Archibald Barr, D.Sc.; lecturer on Electrical Engineering, J. S. Nicholson, B.Sc.

Last week Mr. Maurice Fitzmaurice, chief engineer of the L.C.C., presented the certificates to students of the Crystal Palace School of Practical Engineering, and delivered an address to them.

Institution and Lecture Notes.—Association of Engineers-in-Charge.—By the courtesy of Mr. E. G. Rivers, M.Inst.C.E., chief engineer of H.M. Office of Works, some 70 members of the Association were enabled to inspect the engineering department of the House of Commons on Saturday, the 28th ult., under the guidance of Mr. A. P. Patey, the resident engineer, and his assistant, Mr. W. H. Bowden. A close inspection was made of the battery of boilers installed for supplying the large quantity of hot water required for various purposes, and for steam generation for motive power and heating apparatus. It was pointed out that the large plant there was not sufficient to meet all the demands, and owing to there being insufficient room for any additions, the Westminster Electric Supply Corporation supplied the House with the current required for lighting and power purposes, at 105, 200 and 400 volts. Mr. Davey (Chairman of the Association) proposed, and Mr. Capsey (hon. sec.) seconded, a very hearty vote of thanks to Mr. Patey and Mr. Bowden for the way in which they had entertained the visitors. We regret that in our issue of the 27th ult. Mr. Davey's name appeared as "Darcy."

Walsall and District Electrical and General Engineering Improvement Society.—A general meeting in connection with the above Society was held on August 1st, and a resolution was passed appointing a secretary and committee to draw up a code of rules and a programme for the coming winter's session, to be submitted to a general meeting early in September for approval. Gentlemen wishing to associate themselves with the Society can obtain full information from Mr. C. F. J. Smith, 96, Bentley Lane, Walsall, secretary *(pro tem.)*.

Appointments Vacant.—Engineer-in-charge for Watford U.D.C. (£90); Sunderland Corporation is inviting applications for the appointment of electrical engineer (£800 rising to £1,000); assistant electrical engineer for Erith U.D.C. (£150). See our "Official Notices."

The Magnetic Concentration of Ironsands.—An interesting paper was read some time ago by Mr. J. F. Robertson, M.Sc., before the Canadian Society of Civil Engineers, upon the magnetic concentration of ironsands so that the product might be used in a blast furnace.

The difficulties which present themselves are the fineness of the material, which is overcome by briquetting: the low percentage of iron-bearing minerals in the sand, and the rather excessive amount of titanium present.

The apparatus employed, of which a full and lucid description is given, is in principle based upon the Heberli drum separator, and consists of a flanged brass drum which rotates loose on a hollow axle, through which leads pass to eight electro-magnets filling one-half the drum, with the pole pieces of alternately opposite polarity just clear of the inside of the brass cylinder.

When dry ironsands are used with the apparatus, the electro-magnetic semicircle is set downwards, and the stream of sand is fed at the beginning of the semicircle, the particles of sand instantly falling away, and the particles of magnetite are held up to the surface of the brass cylinder: as the iron particles re-set themselves during their passage over the alternate poles, any grains of sand, are liberated, and fall away, leaving the concentrated iron particles to fall away at the termination of the electro-magnetic semicircle.

When run wet, the electro-magnetic semicircle is placed upwards; then the ironsands are fed on to the brass covering at the beginning of the semicircle so that the tailings fall away, and the iron particles are carried over to the end of the semicircle where they are washed away by water jets.

Owing to the low coefficient of friction of magnetite on brass, the grains tended to accumulate in front of each pole-piece; this difficulty was overcome by fitting longitudinal strips of tape on the brass cylinder.

The titanium is present as ilmenite ($FeTiO_3$) and rutile (TiO_2), and as magnetite has a much higher permeability than ilmenite it should be possible to find a magnetic field strength with which the product contains almost all the magnetite, and very little ilmenite.

The results published are instructive, and show that to treat 300 lb. per hour, the total consumption of power is about ¼ H.P., and at 5d. per unit the cost is 3¼d. to 5d. per ton of sand, with the machine run dry, but run wet the capacity is one-third, and the total costs about 25d. per ton of sand.

One representative dry test gave a dry recovery of 65 per cent. of the total free iron present, and 61 per cent. when the same sand was treated wet.

The process described was employed with apparatus built in the shop of the mining department of McGill University.

The Belgian Electrical Industry.—A Brussels correspondent states that there are in reality only two electrical groups on the Belgian market which are able to compete with each other. The first is the Empain group which makes use of the company known as the Ateliers de Constructions Electriques, of Charleroi and Jeumont (North of France), which has arisen from the Electricité et Hydraulique Co. The second is the German group of the A.E.G. Union, or its Belgian subsidiary, the Union Electrique. It is related of the Empain group that it largely concerns itself with financial matters, and that its principal working sphere appears to be France, where the success of the Paris Metropolitan railway represents an illustration. A second is the Société Parisienne d'Electricité, which has erected a large lighting station at St. Denis, and has entered the lists as a competitor in regard to the future supply of electricity in Paris. In Belgium the Empain group was frequently on the point of receiving a concession for a high speed electric railway between Brussels and Antwerp, but at the last moment the Government was unable to arrive at a decision as to granting a concession. At present the Government announces that on the completion of the works in progress the distance of 27¼ miles between the two cities will be traversed by the steam trains in 25 minutes, and this is thought to imply the indefinite postponement of the electrical scheme. On the other hand, the State has granted to the Société Bruxelloise d'Electricité (an Empain foundation) a 25 years' concession for the lighting of the Brussels railway stations and other similar concessions are in prospect. In addition to these the Empain group, through the Société d'Electricité du Pays de Liège, supplies power to the Liège tramways, and also energy to the towns of Huy and Andenne, the Angleur steel works, &c., while the same group deals with the electric tramways along the Belgian coast, and a large number of the localities which are there electrically lighted. As far as German influence in Belgium is concerned, intimate relations have for years existed with the first Belgian tramways trusts (Chemins de Fer Secondaires, Chemins de Fer Economiques, &c.) The Berlin Co. for Electrical Enterprises has also founded Belgian trusts as the Société Financiere de Transports et d'Entreprises Electriques, the Société Générale d'Entreprises Electriques, and other concerns. In most cases one of these companies competes for a concession, and undertakes the whole equipment which is then transferred to the German firms associated with the Berlin company; or the Belgian Union Electrique becomes the competitor, as in the case of the large central station at Brussels, which is to be opened at the end of this year. It is further pointed out that a good opportunity exists for the sale of cables in Belgium, although the Empain group intends to establish a cable factory on the Franco-Belgian frontier

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review posted as to their movements.

Central Station Engineers.—Mr. David Barry has resigned his position as charge engineer at the Corporation Tramway Power Station, Preston, having been appointed to a similar post under the Leicester Corporation. He was the recipient on Friday last of a dressing case and kit bag, given by the employés. Mr. Jos. F. Simpson, the chief engineer, made the presentation.

Mr. Romero has been appointed chief assistant to the mains superintendent by the Salford T.C. at a salary of £156 per annum, and Mr. Dransfield will take over the testing of the cables at an increased salary of £120 a year.

The Middleton T.C. has increased the salary of the borough electrical engineer by £25 a year.

The Kingston-on-Thames T.C. has granted an honorarium of 20 guineas to Mr. J. E. Edgcome, electrical engineer, and 5 guineas to Mr. Winterhalter, his assistant, for extra services rendered in relaying the cables during the construction of the tramways.

A presentation took place at the Hanley Corporation electricity works on Friday, August 3rd, 1906, to Mr. C. H. Yeaman, chief electrical engineer. It consisted of a very handsome enlarged photo group of the works staff, and was subscribed for by the employés as a small token of the esteem and regard with which Mr. Yeaman is regarded by those under his control.

At the next meeting of the Islington B.C., the following recommendations of the Lighting Committee for the rearrangement of the existing staff (consequent upon the resignation of the deputy engineer) will come up for confirmation: (1) that Mr. M. J. Allward, station superintendent, whose present salary is £200 per annum, be appointed chief assistant and works manager on probation for a period of 12 months at a salary of £225 per annum to be increased to £250 at the end of that period, if his services are found to be satisfactory; (2) that Mr. T. A. G. Margary, mains superintendent, whose present salary is £200 per annum, be appointed distributing engineer on probation for a period of 12 months at a salary of £225 per annum, to be increased at the end of that period to £250 if his services are found to be satisfactory; (3) that Mr. M. H. Adams be appointed constructional and maintenance engineer at his present salary of £160 per annum, to be increased to £200 per annum by two annual increments of £20 if his services are found to be satisfactory; (4) that Mr. R. Lund and Mr. J. J. Hargreaves, mains engineers, be appointed district mains engineers, and that their salaries be increased from £2 15s. to £3 per week and from £2 5s. to £2 10s. per week respectively on the scale of salaries; (5) that Mr. C. H. Higgins, shift engineer, be appointed senior shift engineer, and that his salary be increased from £2 15s. to £3 per week on the scale of salaries; (6) that Mr. C. F. Wade, shift engineer, be granted an additional increment of 5s. on the scale of salaries, viz., from £2 5s. to £2 10s. per week; (7) that Mr. E. T. Gifford, junior shift engineer, be promoted to the position of shift engineer on probation for six months at his present salary; (8) that Mr. T. Simmonds be appointed rectifier attendant on probation for six months, and that his wages be increased from 8d. per hour (37s. 6d. per week) to £2 per week.

Tramway Officials.—The Wolverhampton T.C. has increased the salary of Mr. W. A. Luntley, manager of the tramways, by £25 a year to a maximum of £350.

Mr. L. W. Woodman, borough electrical engineer at Dover, having declined the offer of the T.C. to accept the appointment of engineer to the tramways, at an increased salary of £50 a year, the Council has decided that Mr. E. Carden be given full control, an outside engineer to be called in when necessary.

Mr. C. W. Shepherd has been appointed general manager of the Edinburgh and District Tramways Co., for whom he has acted as traffic superintendent since 1903.

Mr. O. A. Parker, rolling stock superintendent, at Pontypridd, has been appointed to a similar position on the Exeter City Tramways.

General.—Mr. Robert S. Jones, telephone expert, of Montreal, has been appointed Montreal manager of the Bell Telephone Co., a position held until recently by Mr. D. C. Dewar, who died suddenly while on a visit to Toronto a short time ago.

Mr. W. Prior has been appointed by the Hanley T.C. as E.L. canvasser.

Sir W. Crookes has been elected an honorary member of the Royal Academy of Acireale (Sicily).

NEW COMPANIES REGISTERED.

United Electric Tramways Co., of Caracas, Ltd. (89,642.)—This company was registered on July 25th, with a capital of £200,000 in £1 shares, to acquire from the Caracas Construction Co., Ltd. (promoters of this company), the benefit of an agreement between the Caracas Electric Tramways Co., Ltd., and the said Construction Co., and all the shares in the Companhia de Tranvias Electricos de Caracas (known as the "Local Co") agreed to be sold by the said agreement, to adopt two agreements with the said Construction Co. known as the "Sale Agreement" and the "Works Agreement," the latter of which relates, *inter alia*, to the conversion by the Construction Co. of the existing tramways of the Local Co. to electric traction, and to carry on in the City of Caracas or elsewhere in Venezuela the business of a tramway, an electric light and power supply company, a telephone and telegraph company, &c. The first subscribers (each with one share) are:—A. J. Shepherd, Dashwood House, E.C., secretary; F. J. Oliver, 7, Bassingham Road, Wandsworth, S.W., clerk; P. J. V. Capern, Kingswood, Stradella Road, Herne Hill, S.E., clerk; J. E. Gunyon, North Cray, Foots Cray, Kent, secretary; P. Cross, 5, Chatsworth Road, Croydon, secretary; H. D. L. McDougall, 21, Great St. Helens, E.C., director; and A. H. Bartlett, 147, Cannon Street, E.C., solicitor. No initial public issue. The number of directors is not to be less than three or more than seven; the subscribers are to appoint the first (another article states that the first directors will all be nominees of the Construction Co.); remuneration, £200 each per annum (£400 for the chairman). The consideration payable by the company to the Construction Co. under the "Sale Agreement" is £169,993 in fully-paid shares, out of which preliminary expenses are to be paid. The consideration payable by the Construction Co. under the said agreement, the benefit of which is to be purchased by this company, is £38,000 in cash and £51,000 in fully-paid shares of this company. The consideration payable by this company to the Construction Co. under the "Works Agreement" is £170,000 in first debenture stock, and the Construction Co. will contract with sub-contractors for carrying out the greater part of the works for the cost price of the works to such sub-contractors (not exceeding £81,200) plus a fee of £8,000.

Llandudno and District Electric Tramway Construction Co., Ltd. (89,689).—This company was registered on July 25th, with a capital of £100,000 in £100 shares, to adopt agreements (1) with the Carnarvonshire Electric Traction Syndicate, Ltd., relating to the acquisition of certain light railway orders authorising the construction and working of certain lines of light electric railway between Colwyn Bay, Llandudno and Deganwy, together with the undertaking of the Llandudno and Colwyn Bay Electric Traction Company, Ltd., subject to certain liabilities, and (2) with Bruce Peebles & Co., Ltd., relating to the completion of the construction and equipment of the said light railways or part thereof, and to carry on the business of tramway, railway, omnibus and electrical, steam or other mechanical carriage and van proprietors, carriers of passengers and goods, electricians, engineers, &c. The first subscribers are:—T. Stoker, 42, Egerton Crescent, S.W., ret., 2 shares; C. H. Rigg, 78-80, Palmerston House, Old Broad Street, E.C., member of Stock Exchange, 2 shares; H. C. Thurley, Palmerston House, Old Broad Street, E.C., stockbroker's manager, 1 share; C. G. Nicole, Brooklyn, Chingford, clerk, 1 share; A. W. Tait, Basildon House, Moorgate Street, E.C., chartered accountant, 1 share; L. W. Hawkins, Basildon House, Moorgate Street, E.C., chartered accountant, 1 share; and F. J. W. Park, 62, St. Alban's Crescent, Wood Green, N., clerk, 1 share. Minimum cash subscription, 400 shares; the number of directors is not to be less than three or more than seven; the subscribers are to appoint the first; qualification, £200; remuneration (except managing directors or committee of management), £150 each per annum (chairman, £200).

Turners & Manville, Ltd. (89,658).—This company was registered on July 26th, with a capital of £50,000 in £1 shares, to acquire the business of manufacturers of and dealers in asbestos, asbestos goods, non-conducting coverings, electrical fittings, accessories and sundries, &c., carried on by the London branch of the H. W. Johns Manville Co. and by the British Johns Manville Co., Ltd., in England and elsewhere, and to adopt agreements (1) between the Asbestos and Asbestic Co., Ltd., of the first part, the H. W. Johns Manville Co. of the second part, Turner Bros., Ltd., of the third part, and S. Turner, jun. (for this company) of the fourth part; (2) between the H. W. Johns Manville Co. of the one part, and the said S. Turner, jun. (for this company) of other part; and (3) between the H. W. Johns Manville Co., on behalf of the British Johns Manville Co., Ltd., of the one part, and S. Turner, jun. (for this company) of the other part. The first subscribers are:—S. Turner, Chaseley, Rochdale, asbestos manufacturer, 1 share; T. F. Manville, 100, William Street, New York, U.S.A., asbestos and magnesia manufacturer, 6 shares; R. Turner, Denehurst, Rochdale, cotton manufacturer, 1 share; C. H. Turner, Woodroyd, Rochdale, cotton manufacturer; S. Turner, jun., Craigmore, Rochdale, asbestos manufacturer, 1 share; H. R. Turner, Denehurst, Rochdale, manufacturer; and F. W. Turner, Spring Mount, Rochdale, cotton manufacturer, 1 share. No initial public issue. The number of directors is not to be less than three or more than nine; the first are S. Turner, T. F. Manville and S. Turner, jun.; qualification, £500 shares or stock; remuneration as fixed by the company.

British Taxi-Motor Cab Co., Ltd. (89,648).—This company was registered on July 26th, with a capital of £150,000 in £1 shares, to adopt an agreement with G. Garnier, and to carry on the business of motor-cab proprietors, owners of petrol, steam, gas, electric or other vehicles of any kind, carriers of passengers and goods, garage keepers, electricians, &c. The first subscribers (each with one share) are:—J. Pickett, Tachbrook Road, Feltham, Middlesex, accountant; R. H. Loés, 26, Grosvenor Road, Highbury, N., clerk; T. Palmer, 6-8, Eastcheap, E.C., merchant; M. Narizzano, 177, Maida Vale, W., merchant; H. Knight, 59, Uplands Road, Hornsey, N., clerk; W. Howlett, 22, Eleanor Road, Romford Road, E., clerk; and L. Lee, 293, Coldharbour Lane, Brixton, S.W., traveller. No initial public issue. The number of directors is not to be less than three or more than nine; the subscribers are to appoint the first; qualification, 250 shares; remuneration, £150 each per annum (£50 extra for the chairman), and a share in the profits. Registered office, 40, Botolph Lane, E.C.

Rushmore Lamps, Ltd. (89,656).—This company was registered on July 26th, with a capital of £3,000 in £1 shares, to acquire the business carried on at 49, Rupert Street, London, as "Stewart & Tyler," and to carry on the business of manufacturers, letters-on-hire, repairers and cleaners of and dealers in search-lights and lamps of all kinds, electric, gas, acetylene gas and other illuminating apparatus, &c. The first subscribers (each with one share) are:—G. S. S. Monck, The Fishery, Maidenhead, director; S. F. Tyler, 7, Norroy Road, Putney, S.W., director; W. L. Stewart, 24, Addison Gardens, W., director; E. C. Parry, 121, Mount Street, W., secretary; E. G. Mawby, 35, Norfolk Street, Strand, W.C., solicitor; C. Piper, 35, Norfolk Street, Strand, W.C., solicitor; and A. E. Pegg, 88, North View Road, Hornsey, law stationer. No initial public issue. The number of directors is to be three; the first are G. S. S. Monck, S. F. Tyler, and W. L. Stewart; qualification, 100 shares; remuneration (except managing director), £90 each per annum.

Railway and Tramway Trust, Ltd. (89,684).—This company was registered on July 28th, with a capital of £1,000 in 10s. shares, to carry on the business of a railway, tramway and electric light and power company, &c. The first subscribers (each with one share) are:—R. Sturgeon, 28, Southampton Street, Camberwell, S.E., gentleman; C. E. Harris, 3, Radley Road, Bruce Grove, N., gentleman; W. A. Prince, 13, The Glebe, Blackheath, S.E., gentleman; O. F. Hunt, Holmwood, Goldsmith Gardens, Acton, W., secretary; F. F. Shipton, 7, Moylan Road, Hammersmith, W., gentleman; F. Mills, 90, Esmond Road, Bedford Park, Chiswick, W., gentleman; and G. H. Monson, 48, Fordnook Avenue, Ealing Common, W., articled clerk. No initial public issue. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first; no qualification necessary for first directors; qualification of subsequent directors as fixed by the company: remuneration as fixed by the company. Registered office, 5, Howick Place, Victoria Street, Westminster.

Kingston & Co., Ltd. (89,727).—This company was registered on August 1st, with a capital of £2,000 in £1 shares, to acquire the business of electrical engineers, electroplaters, art metal workers, and dealers carried on by Kingston & Co., at 8, Trinity Square and Northdown Road, Margate, to adopt an agreement between F. J. A. Kingston, H. M. Wainman and A. Fairweather of the one part, and J. W. Scarlett of the other part, and to carry on the said business and that of electric light installers, manufacturers and repairers of all appliances connected with the installation of electric light, &c. The first subscribers (each with one share) are:—A. Fairweather, 3, Westcliff Road, Margate, retired fruit grower; F. H. Fairweather, 3, Westcliff Road, Margate, builder; F. Kingston, 8, Trinity Square, Margate, electrical engineer; F. J. A. Kingston, 8, Trinity Square, Margate, electrical engineer; H. M. Wainman, Northcliffe, Lewis Avenue, Margate, electrical engineer; J. W. Scarlett, 36, High Street, Margate, electrical engineer; and W. F. Wilson, 3, Cecil Square, Margate, solicitor. No initial public issue. Registered without articles of association. Registered office, Northdown Road, Margate.

Hawthorn Fire Detector Co., Ltd. (89,697).—This company was registered on July 30th, with a capital of £30,000 in £1 shares, to acquire and turn to account the inventions and patents of H. Hawthorn for improvements in electric fire alarms and thermo indicators, and in automatic transmitters for electric fire alarms and other signals, &c. The first subscribers are T. R. Sanders, 3, Vernon Mansions, W., gentleman, 100 shares; Mrs. A. L. Sanders, 3, Vernon Mansions, W., 1 share; J. W. Cleland, 4, Harcourt Buildings, E.C., barrister, 100 shares; H. Hawthorne, 79, Fenchurch Street, E.C., engineer, 100 shares; W. Luffsmith, Ferncroft, Kingston Road, Teddington, Stock Exchange accountant, 5 shares; E. E. Bailey, 11, Queen Victoria Street, E.C., fire escape manufacturer, 2 shares; and T. D. Davis, 22, St. Mary Axe, E.C., shipbroker, 100 shares. Minimum cash subscription, 6,000 shares. The number of directors is not to be less than three or more than five; the first are T. R. Sanders, J. W. Cleland and H. Hawthorn; qualification, £100; remuneration, £50 each per annum and a share in the profits.

Vera Cruz Electric Light, Power and Traction Co., Ltd. (89,686).—This company was registered on July 28th, with a capital of £300,000 in £1 shares, to carry on in Mexico or elsewhere the business of suppliers of electric light, power and traction, to acquire and turn to account concessions for the utilisation of water-power in the generation and distribution of electricity, &c. The first subscribers (each with one share) are:—C. Reed, Elm Tree Villa, Rosenau Road, Battersea Park, S.W., clerk; J. Baker, 23, Seward Road, Hanwell, clerk; C. J. Newman, Holmwood, Gravesend, accountant; W. P. Devine, 59, Loftus Road, Shepherd's Bush, W., clerk; E. A. Andrews, Percy House, Almeric Road, Clapham Common, S.W., incorporated accountant; W. R. Bignell, 10, Grove Terrace, Squires Lane, Finchley, N., clerk; and G. Hutchins, 62, Flanders Road, Bedford Park, W., clerk. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £500; remuneration (except managing director) as fixed by the company. An issue of £300,000 first mortgage debentures is specifically authorised, and the total borrowing powers of the directors are restricted to £500,000. Registered office, 35, Great St. Helens, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Western Telegraph Co., Ltd. (6,886).—This company's annual return was filed on June 6th, when 207,930 shares had been taken up out of a nominal capital of £2,500,000 in 250,000 shares of £10 each. £10 per share has been called up on 130,000, and £1,300,000 has been received. £779,300 is considered as paid on 77,930 shares. Mortgages and charges: £862,000.

West India and Panama Telegraph Co., Ltd. (11,116).—This company's annual return made up to June 6th, has been filed. 88,321 ordinary, 34,536 first preference, and 4,669 second preference shares have been taken up out of a nominal capital of £2,445,630 in 200,000 ordinary, 34,563 first preference, and 10,000 second preference shares of £10 each. £1,275,530 is considered as paid. Mortgages and charges: £80,000.

Urban Electric Supply Co., Ltd. (57,986).—This company's annual return was filed on May 23rd, when the entire capital of £650,000 in £5 shares (80,000 preference and 50,000 ordinary) had been taken up and paid for in full. Mortgages and charges: £200,000.

South Metropolitan Electric Tramways and Lighting Co., Ltd. (61,593).—A trust deed dated July 5th, 1906, to secure £150,000 debenture stock (with power to increase up to a total of half the amount of the issued capital for the time being), has been registered. Property charged: The company's undertaking and general assets, present and future. Trustees: Electric and General Investment Co., Ltd., 1-2, Great Winchester Street, E.C.

Standard Electric Co., Ltd. (London) (68,643).—Issue on July 6th of £3,500 5 per cent. debentures, part of series created May 25th, 1906, to secure £4,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: L. D. Gunn, Abutshi, Forcados, South Nigeria. No trustees. No previous issue of same series.

Perth Electric Tramways, Ltd. (55,935).—Issue on June 30th of £600 debentures, part of series created December 22nd, 1903, to secure £50,000, charged on the company's undertaking, revenues, &c., subject to first debenture stock. Trustees: Lord Arthur Butler, 7, Portman Square, W.; and J. S. Austen, 68, Dashwood House, E.C. Previously issued of same series: £47,100.

Tramways and Light Railways Estates Co., Ltd. (65,201).—This company's annual return was filed on June 1st, when 5,021 shares had been taken up out of a nominal capital of £100,000 in £10 shares. £2 per share has been called up, resulting in the receipt of £10,044, including £2 paid on one forfeited share. Mortgages and charges: Nil.

Veritys, Ltd. (49,784).—This company's annual return was filed on June 22nd, when 200 management, 5,343 ordinary, 7,000 first preference and 7,000 second preference shares had been taken up out of a nominal capital of £210,000 in 200 management shares of £1 each, and 6,980 ordinary, 7,000 first preference and 7,000 second preference shares of £10 each. £1 per share has been called up on 30 management, and £10 per share on 1,142 ordinary, 4,670 first prefexence and 7,000 second preference, resulting in the receipt of £128,150. £65,470 is considered as paid on 170 management, 4,200 ordinary and 2,330 first preference. Mortgages and charges: £40,000.

Standard Electric Co., Ltd. (68,643).—This company's annual return was filed on May 24th, when 3,077 preference and 5,000 ordinary shares had been taken up out of a nominal capital of £10,000 in 5,000 preference and 5,000 ordinary shares of £1 each. £1 per share has been called up on 4,177, and 10s. per share on 400 shares, and £4,202 has been received, leaving £175 in arrears. £3,700 is considered as paid, being £1 per share on 3,500 shares and 10s. per share on 400 shares. Mortgages and charges: Nil.

Wrexham and District Electric Tramways, Ltd. (71,213).—This company's annual return was filed on June 1st, when the entire capital of £50,000 in 5,000 preference and 5,000 ordinary shares of £5 each had been taken up. £5 per share has been called up on 4,700 preference and 4,697 ordinary, and £3 per share on three ordinary, and £46,989 has been received. £5 remains in arrears. £600 is considered as paid on 300 preference and 300 ordinary. Mortgages and charges: nil.

Woodhouse and Baillie Riviera Electricity Co., Ltd. (62,791).—This company's annual return was filed on May 15th, when 14,700 first preference, 4,000 second preference, and 4,000 ordinary shares had been taken up out of a nominal capital of £50,000 in 16,000 first preference, 20,000 second preference, and 14,000 ordinary shares of £1 each. £1 per share has been called up on 14,700 first preference, resulting in the receipt of £14,660. £40 remains in arrears. £8,000 is considered as paid on 4,000 second preference and 4,000 ordinary. Mortgages and charges: nil.

James & Browne, Ltd. (electricians, &c., London) (72,372).—A trust deed dated June 29th, 1906, to secure £6,000 debentures, charged on certain freehold and leasehold properties in King Street and Westcroft Square, Hammersmith, and the company's undertaking and property, present and future, including uncalled capital, has been registered. Trustees: J. W. Ellis, Portland House, Basinghall Street, E.C., and E. Hughes, 106, Holland Road, Kensington. Issue on July 5th of £1,900 5 per cent. debentures, part of above-mentioned series, also registered. No previous issue of same series.

Uxbridge and District Electric Supply Co., Ltd. (62,706).—Issue on July 10th of £2,200 second debentures, part of series created same date, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. No previous issue of same series.

Frank Suter & Co., Ltd. (electrical engineers, London) (57,193).—Particulars of £5,500 debentures, created June 27th, 1906, charged on the company's undertaking and property, present and future, including uncalled capital, have been filed pursuant to Sec. 14 (4) of the Companies' Act, 1900. No trustees.

Fladbury Electric Light and Power Co., Ltd. (63,942).—This company's annual return, made up to May 26th, has been filed. 855 shares have been taken up and paid for in full out of a nominal capital of £2,000 in £1 shares. Mortgages and charges: £300.

Isle of Wight Electric Light and Power Co., Ltd. (53,823).—This company's annual return was filed on June 13th, when the entire capital of £150,000 in 20,000 ordinary and 10,000 preference shares of £5 each had been taken up and paid for in full. Mortgages and charges: £65,902.

Scottish House-to-House Electricity Co., Ltd. (29,232).—A further lien for £400 and 6 per cent. interest was endorsed on a charge dated March 31st, 1904, on June 28th last. Property charged: The company's assets, present and future, including the Coatbridge and Airdrie undertakings and uncalled capital. Holders: County of London Electric Supply Co., Ltd., Moorgate Court, E.C.

Electromotors, Ltd. (60,826).—This company's annual return was filed on June 6th, when 40,870 shares had been taken up out of a nominal capital of £50,000 in £1 shares. 16s. per share has been called up, resulting in the receipt of £32,696. Mortgages and charges: Nil.

Dulverton Electric Lighting Co., Ltd. (80,071).—A memorandum of satisfaction in full of a mortgage dated May 9th, 1905, securing £150, has been filed.

Chislehurst Electric Supply Co., Ltd. (50,980).—Issue on July 2nd of £5,000 5 per cent. debentures, part of series created February 23rd, 1900, to secure £10,000, charged on the company's lands, buildings, plant, undertaking and general assets, present and future. No trustees. Previously issued of same series: £5,000.

Potteries Electric Traction Co., Ltd. (57,968).—This company's annual return was filed on July 13th, when 24,500 ordinary and 24,500 preference shares had been taken up out of a nominal capital of £600,000 in 30,000 ordinary and 30,000 preference shares of £10 each. £10 per share has been called up on 17,834 ordinary and 24,500 preference and £423,340 has been received. £66,660 is considered as paid on 6,666 ordinary shares. Mortgages and charges: £245,000.

Calcutta Tramways Co., Ltd. (14,764).—This company's annual return was filed on June 1st, when 105,000 old and 32,610 new shares had been taken up out of a nominal capital of £700,000 in 140,000 shares of £5 each. £502,950 has been received and £185,100 is considered as paid. Mortgages and charges: £350,000. On June 25th an increase of capital to £850,000 was registered.

Orient Electric Power Syndicate Ltd. (89,446).—Issue on July 23rd of £2,500 per cent. debentures, part of a series created July 12th, 1906, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. No previous issue of same series.

Keynsham Electric Light and Power Co., Ltd.—Issue on July 18th of a 5½ per cent. debenture for £26, part of series created October 9th, 1905, to secure £1,500, charged on Court House and garden, with messuage adjoining, at Keynsham, Somerset, and the company's undertaking and property, present and future, including uncalled capital. Holder: W. J. Robinson, Lion Chambers, Broad Street, Bristol. No trustees. Previously issued of same series, £1,104.

Globe Telegraph and Trust Co., Ltd. (7,465).—This company's annual return was filed on June 7th, when 181,127 preference and 181,127 ordinary shares had been taken up out of a nominal capital of £5,000,000 in 250,000 preference and 250,000 ordinary shares of £10 each. £10 per share has been nominally called up on 45,009 and £439,115 has been received. £3,167,450 is considered as paid on 316,745. Mortgages and charges: Nil. (Certain shares were issued at a discount prior to 1885, and the company has been estopped from denying that the same are fully paid up.)

Cowper-Coles Inventions Development Co., Ltd. (65,755).—Issue on July 4th of £70 6 per cent. debentures, part of series created by resolutions of June 1st and July 4th, 1906, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. No previous issue of same series.

Chiswick Electricity Supply Corporation, Ltd. (38,854).—Issue on July 18th of £500 4½ per cent. debentures, part of series created by resolutions of November 2nd, 1900, and March 8th, 1901, to secure £50,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £33,000.

Uxbridge and District Electric Supply Co., Ltd. (62,706).—Issue on July 24th of £4,000 6 per cent. debentures, part of series created July 10th, 1906, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series, £2,200.

Tyer & Co., Ltd. (56,760).—This company's annual return was filed on June 23rd, when 22,007 shares had been taken up out of a nominal capital of £25,000 in £1 shares; £1 per share has been called up on 2,007, resulting in the receipt of £2,000; £7 remains in arrears; 20,000 shares are considered as fully paid. Mortgages and charges: Nil.

Mutual Telephone Co., Ltd. (56,627).—This company's annual return made up to December 15th, 1905, was filed on July 18th, 1906; 6,283 preference and 10,348 ordinary shares have been taken up out of a nominal capital of £250,000 in 20,000 preference and 30,000 ordinary shares of £5 each; 6d. per share has been called up, resulting in the receipt of £1,184 7s. 6d., including cash paid in advance of calls. Mortgages and charges: Nil.

Madras Electric Tramways (1904), Ltd. (80,361).—A trust deed, dated July 20th, securing £4,900 debenture stock created by resolution of July 19th, 1906 (supplemental to a trust deed dated March 18th, 1904, covering £50,000 5 per cent. mortgage debenture stock), has been registered. Property charged: The company's undertaking and property, present and future, including uncalled capital. Trustees: Anglo-American Debenture Corporation, Ltd., 20, Birchin Lane, E.C.

Electricity Supply Co. for Spain, Ltd. (29,103).—This company's annual return was filed on July 23rd, when 31,660 preference, 19,900 ordinary, and 100 founders' shares had been taken up out of a nominal capital of £205,000 in 40,000 preference shares of £5 each, and 19,900 ordinary, and 100 founders' shares of 5s. each. 5s. per share has been called up on 19,900 shares, and £4,975 has been received. £173,325 is considered as paid on 34,660 preference, and 100 founders'. Mortgages and charges: £205,800.

Pulford Bros., Ltd. (63,544).—This company's annual return was filed on June 12th, when 1,620 shares had been taken up out of a nominal capital of £3,000 in £1 shares. £1 per share has been called up on 1,170, resulting in the receipt of £1,170. £450 is considered as paid on 450 shares. Mortgages and charges: £500.

Boardman Electrical Patents Co., Ltd. (68,712).—This company's annual return made up to December 28th, 1905, was filed on June 6th, 1906. 1,000 shares have been taken up out of a nominal capital of £2,000 in £1 shares. £1,000 is considered as paid. Mortgages and charges: Nil.

Electromobile Co., Ltd., London (75,139).—A memorandum of satisfaction to the extent of £9,000, being balance outstanding of a mortgage dated August 10th, 1904, stamped to cover £20,000, of which only £19,000 was advanced, has been filed. A mortgage dated July 19th, 1906, to secure £9,000 and further advances, with 5½ per cent. interest (the instrument being stamped to cover £20,000), has also been registered. Property charged: 10 per cent. of all moneys payable to the company under contracts for sale of automobiles, for garage or supply of electricity, or for insurance or any other services in connection with automobiles or for the hire thereof. Holders: North of England Trustee Debenture and Assets Corporation, Ltd., 45, Spring Gardens, Manchester.

CITY NOTES.

Crompton & Co., Ltd.

The eighteenth annual general meeting of the shareholders of this company was held on Friday last at Salisbury House, London Wall, Mr. John Trotter in the chair.

In proposing the adoption of the report (Electrical Review, p. 187), the Chairman said he had to congratulate the shareholders upon a marked improvement in the company's affairs. When he met them last year he was afraid he had rather a pessimistic tale to tell. It was distinctly a bad year, and at that time they were still suffering, as they were now, from the extremely low prices that prevailed and the very keen competition that existed in the electrical manufacturing world. But he was able to tell them then that although they deplored the conditions of things and hoped for a return to the better prices that prevailed some time ago, they were not allowing themselves to be simply waiters, but that they were taking every possible precaution to provide for a possible continuance for a long time of low prices. With that object in view he told them that they were reorganising their works; they were examining their methods and were seeking every possible economy they could find, and at the same time trying to bring things up to date as much as possible. Last year he had to tell them that the results were really saved by the contract department, and that the manufacturing results were depressing, and he told them then that they had some excellent contracts in hand and that they looked forward to some improvement during the then coming year. They hardly dared then to hope that the effect of their previous work would be so rapidly marked as to enable them with any confidence to look forward to distinctly better results, but, in the present report, that which was most satisfactory to him was the statement that "the results of the year's working at the company's works at Chelmsford show a marked improvement". To him that was the most encouraging feature—that not only had the contracts resulted as well as they expected, but that they had also done distinctly better at Chelmsford than they anticipated. That, he was glad to say, was not a mere "flash in the pan," but they considered it was only the beginning of distinctly better times at Chelmsford. An immense amount of work had been done, and they were now getting the results, and if in a year like the present, when the whole industry was suffering from bad prices, they could make a distinct profit, he looked forward with some confidence to the immediate future. The reasons for that change were economies, improvements, and also very markedly an increased output. It required some resolution to invest the capital of the company in enlarging the works when prices were as bad as they had been and still were, but they felt that a large output was essential to cheap production, and they went with confidence into the enlargement of the works, and the result had more than justified the expenditure. They were contemplating a still further enlargement in order satisfactorily to cope with the business—a business which was constantly growing, and which, if anything like good times returned, ought to be very satisfactory to the shareholders in the future. There had been several changes in the staff of the company. One had been the retirement of Mr. Reeves from the general managership, rendered necessary by increasing years, and the very great amount of work that fell upon him in connection with other companies with which they were interested; and his replacement by Mr. Stevens, who for many years had been chief engineer to the company. Mr. Reeves's retirement did not sever his connection with the company, as he still remained with them as financial adviser. Also Col. Crompton had transferred his energies from that of managing director to that of consulting engineer, in order to leave room for Mr. Stevens, who took complete and continuous charge of the whole affairs of the company. They had appointed Mr. Hodgson, a very old servant of the company, to the managership of the works. There had been other changes in the staff, and it was very satisfactory to know that they had been able to practically fill all the important posts in the company with old servants, so that there was that harmonious working which was very essential to the well-being of a company like theirs. The available balance was £13,372, against £2,713 last year, a most encouraging result. All along they had done better. Two years ago he told them that Australia was not producing as much as it ought to. This year Australia had responded, and they had made a very nice profit there. Seeing that they had got that large amount of £13,372, it was obvious that if they had wished they could have declared a larger dividend than the 2½ per cent. they recommended, but they had thought that it was wise and prudent to be conservative on that point, and to carry forward the large sum of £5,816. The very improvements that they had made at the works had brought about a cause for some caution. They had by improved methods and improved patterns reduced very materially the cost of their productions. That very cause had left a certain amount of the old patterns on their hands, and they resolved last year that they would not hold these things but dispose of them as rapidly as possible. During the year they had done a great deal in that direction, and had thereby made a loss of £1,800. During the year before them they would continue that policy, and it was with a view to possibly having to provide against a loss of that kind that they made such a large carry forward. Their order book at the present time was exceptionally full, and they had got one very large contract for the Madras Electric Supply Corporation of £174,000. Taking that large amount out altogether the remaining amount was also a record, so that they had got an exceptional amount of good work on hand, and work which could not be otherwise than very remunerative to the company. They had spent over £10,000 on the enlargement of the works during the year, but they had only increased the figures in the accounts by £6,000. The stock in hand was £141,000—a very great deal of that was work in progress, and a great part was contract work. There had been an increase in the trading and the administration and office expenses, but it was satisfactory to point out that the percentage of those expenses and wages to output showed a very large falling off indeed, owing to the fact that they had done a larger business, and the result was reflected in the gross profit which amounted to £69,500, against £55,000 last year, and in the net profit which was £20,000 as against £9,128. He hoped that next year they would see a still further improvement in the company.

Col. R. E. Crompton, in seconding the resolution, said that if prices only rose to the ordinary average level, the position of the company would be an exceedingly strong one.

The report was adopted.

Liverpool Overhead Railway Co.

The report of the directors for the half year ending June 30th, 1906, shows that the gross revenue receipts amounted to £37,642 1s. 1d., and the working expenses to £30,300 4s. 9d. The number of passengers carried during the last two years was as follows:—

	Half-year ending Dec. 31, 1904.	Half-year ending June 30, 1905.	Half-year ending Dec. 31, 1905.	Half-year ending June 30, 1906.
First class	705,215	673,637	625,430	608,870
Third class (including tramways) ..	3,523,985	3,169,953	3,346,930	3,036,003
Workmen (special return tickets) ..	1,384,552	1,714,523	1,645,312	1,800,227
Total	5,613,752	5,558,113	5,617,672	5,454,100

The introduction of differential and cheaper fares, as frequently urged by the shareholders, with a view of meeting the competition of the tramways and the improved service of the Lancashire and Yorkshire Railway, had not resulted in the increased traffic expected. The receipts per passenger had been 1·75d. as against 1·82d. last year. The interchange of traffic with the Lancashire and Yorkshire Railway, although disappointing, showed a gradual increase. The through service between Southport and Dingle, without change of carriage, was inaugurated in February and extended in June, and the directors trusted that this would become a valuable traffic.

Revenue Account.

Receipts from passenger traffic amount to	£36,695	5 11
Miscellaneous receipts and interest	946	15 2
	£37,642	1 1
Less working expenses	30,300	4 9
	£7,341	16 4
Deduct interest on mortgage debentures, and on calls paid in advance	4,329	7 5
	£3,012	8 11
Add balance brought forward, December 31st, 1905..	3,784	7 4
Leaving available for dividend	£6,796	16 3

Out of this balance the directors recommend the declaration of a dividend of 5 per cent. per annum on the (1892) preference shares (less income-tax), leaving a balance of £3,796 16s. 3d. to be carried forward to next half-year.

Dublin & Lucan Electric Railway Co.

The directors' report to June 30th, 1906, shows that after providing for debenture interest there is an available balance of £875, out of which the directors recommend the payment of the usual half-yearly dividend on the 5 per cent. preference shares; that £100 be paid to the contractors on account of the principal sum remaining due to them for electrical equipment; that £100 shall be written off working stock account, on foot of which £428 has been paid for a new electric locomotive during the past half-year; and that the balance of £200 be carried forward to next half-year. It is proposed to make the dividend warrants payable on September 15th, 1906.

Waterloo and City Railway Co.

The half-yearly general meeting of this company was held at the general offices of the London and South-Western Railway, Waterloo, S.E., on Thursday last week, Sir Charles Scotter presiding.

In moving the adoption of the report (Electrical Review, page 189), the Chairman said that there was very little for him to say to the shareholders. As they knew, the company was a dying company—would, in six months, be dead and buried. There was nothing in the report for him to enlarge upon, except to say that the balance available for dividend was £8,838, as against £8,759, the figure for the corresponding period of last year. They proposed to pay a dividend of 3 per cent. on the ordinary shares, for although they could have paid 3¼ per cent., it was thought better not to do so, but to carry the balance of £738 forward. Any surplus revenue which remained when the company was wound up, would be dealt with in such a way that the shareholders would get the benefit. The Bill which the South-Western Railway Co. had promoted in

this session, and which contained powers to take over their company, had received Royal assent, and before the shareholders met again in December they would all receive circulars from the secretary informing them of the terms upon which the South-Western Co. had taken over the undertaking, and asking the shareholders as to what class of stock in the South-Western Co. they would prefer to accept. If any shareholder failed to fill in those particulars on the forms sent him, the company would allocate to him 3½ per cent. South-Western preference stock. That would mean that, for every £100 he held in the Waterloo and City Co., he would receive £105. The working of the line had been safe and regular—facts which were attributable to the manner in which Mr. Jones, their engineer, attended to the work. He (the chairman) was sorry to say that since the last meeting Mr. Jones had met with a rather serious accident, through a gauge glass in the engine room bursting and destroying one of his eyes. The eye had, in fact, been removed. Mr. Jones was now perfectly well again, and at work, and all they could say was that it was a blessing the accident was no worse. He was sure the directors and the shareholders would join in an expression of sympathy with their engineer. Since the starting of the line, they had carried 40 million passengers and had never had an accident—a fact which was largely due to the way in which Mr. Jones performed his duties.

Lt.-Col. CAMPBELL seconded the motion for the adoption of the report, and it was then carried.

A vote of thanks to the chairman terminated the proceedings.

Anglo-American Telegraph Co., Ltd.

THE half-yearly meeting of this company was held at Winchester House, Old Broad Street, E.C., on Friday, August 3rd, Mr. F. A. Bevan in the chair.

In moving the adoption of the report (see ELECTRICAL REVIEW, p. 186), the CHAIRMAN remarked that the company had now been in existence for 40 years. All sorts of predictions were made when the cables were first laid as to their durability, but, on the whole, they had lasted for a much longer period than it was thought or predicted they would. The oldest of their cables was the 1873 one, the deep-sea part of which was, he believed, as good as on the day it was laid down. He might congratulate the shareholders that the present half-year had been the best the company had experienced. The gross pool amounts of the three companies—the Anglo-American, the Western Union, and the Direct U.S. Cable—amounted to £328,000. Of that amount the Anglo-American Co. took £195,281. Besides that they had increased receipts from interest and transfer fees, and also through the charter of the *Minia*. They had received for the charter of the *Minia* £8,094, or £5,494 more than in the corresponding half-year; thus, the total increase in receipts was £23,588. On the other side, the working expenses had increased by £2,049, and there was the item of taxes in Newfoundland, amounting to £2,249. Another item was £6,100 for charter of ships and repair of cables. They had not put £10,000 to renewal fund, as in the previous year, because that fund now exceeded £1,000,000, and the net increased amount available for dividend was £21,941. Looking at the position generally, he remembered that there were times early in the history of the company when they earned larger sums, but that was when the tariff was higher, and not since it was put at 1s. a word. Referring to the 1873 cable, the Chairman remarked that it was proposed to lay about 80 miles of a heavier cable at the shore ends, as the steam trawlers had constantly caused breaks. The cost of the work would be about £25,000, and it was hoped that by that time there would just be £25,000 over the renewal fund, so that they would not have to dip into that fund. In conclusion, the Chairman again referred to the Newfoundland taxes, and said that the company contended that they had only three, or at the most four, cables, while the authorities said they had seven. The cables were across the island, and it was his contention, and that of the directors, that the cables which went across in that way were one cable. They simply ran through the island and came out at the other end. That was the contention they were making in their claim.

Sir GERALD FITZGERALD seconded the motion, and it was carried unanimously.

Great Northern and City Railway Co.

THE EARL OF LAUDERDALE presided over the sixteenth half-yearly general meeting of this company, held on Friday last week at the Westminster Palace Hotel.

In moving the adoption of the report (see ELECTRICAL REVIEW, page 189), the CHAIRMAN said that the traffic had continued to increase during the half-year, the total number of passengers having been 8,087,740 during the half-year, against 7,527,634. The number of through-route season tickets had been well maintained, and averaged for the half-year 2,690 per day. The through bookings with the Great Northern Railway showed an increase of 32·2 per cent., while the traffic from the City and South London also showed an increase. Local traffic was about three-quarters of the whole, through or interchange traffic accounting for the remainder. The train service during the coming winter would be at intervals of two minutes during the rush hours in place of 2½ minutes, and the mid-day service would be increased to 3½ minutes. The improvements in the service would be completed during September. The gross revenue for the half-year had been £49,390, as against £46,240. As to the estimate of further expenditure on capital, £100,000 had been set aside in case the opportunity presented itself of proceeding with the extension to Lothbury, £34,280 had been carried to net revenue, as against £21,523 for the corresponding period of last year. The new rolling stock had been delivered, and with regard to the transfer of the railway, the agreement was that it should be transferred on February 14th, 1907, the latest date; but it was proposed to take the line over from the contractors on January 1st next, the contractors holding themselves responsible to meet all liabilities up to the original date of transfer. It was believed that the traffic of the line would increase very largely in the future, and he might mention that the number of passengers carried during July was 1,072,408, against 961,985 for July of last year.

Mr. C. STEEL seconded the motion, and it was carried.

London, Tilbury and Southend Railway Co.—Mr. A. L. Stride, presiding at the half-yearly meeting of the company, after referring to the satisfactory traffic and revenue returns for the period, stated that at the present time they were seriously considering the question whether they should not set up their own electrical installation, and do the work themselves, rather than continue the provisional agreement with the District Co. for the provision of electrical energy.

Baker Street and Waterloo Railway.—The report of this company for the half-year ended June 30th last states that the capital expenditure amounted to £328,533. The section of the line between Kennington Road Station, now called Westminster Bridge Road Station, and Baker Street Station, was opened for traffic on March 10th last. The number of passengers carried during 16 weeks to June 30th last has been 3,006,276. The revenue amounted to £23,490. Working expenditure, so far as it is payable by the company, has been £16,680. The charges for maintenance and administration are payable by the Underground Electric Railways Co. of London, Ltd., until the construction of the railway has been completed. The balance carried to credit of net revenue is £6,809. Arrangements are being made with other railways for the issue of through tickets. Under the advice of Sir George Gibb the directors have adopted a new system of fares to replace the uniform 2d. fare. The Elephant and Castle Station was opened on August 5th, and it is hoped that the section from Baker Street to Edgware Road will be ready for opening before the end of the year. The half-yearly meeting was held on Wednesday.

Northallerton Electric Light and Power Co., Ltd.—An extraordinary general meeting was held at Northallerton last week, Mr. E. C. L. Ringrose presiding. The following resolution was carried unanimously:—

That the capital of the company be reduced from £10,000 to £6,500, and that such reduction be effected by cancelling paid up capital which has been lost or is unrepresented by available assets to the extent of 14s. per share on each of the 4,561 ordinary shares of £1 each, which have been issued, and by cancelling capital to the extent of 14s. per share on each of the 439 ordinary shares of £1 each which have not been issued, and by converting 2,100 preference shares (part of the 3,849 preference shares of £1 each which have never been issued) into 7,000 ordinary shares of 6s. each, and by reducing the nominal amount of the ordinary shares to 6s. each.

Chatham and District Light Railways Co.—The report for the half-year to June 30th, states that the receipts were £16,757, and expenses £10,897. The directors recommend dividends at the rate of 5 per cent. per annum on the preference, and at the rate of 3 per cent. per annum on the ordinary shares, for the half-year, carrying £1,116 to revenue new account. The construction is nearing completion of the extension to Rainham, which it is anticipated will prove remunerative. No provision for depreciation has been made in the accounts, as the directors propose, as usual, to deal with the matter when the accounts are made up at the end of the year.

Chloride Electrical Storage Co., Ltd.—The directors' report for the past year shows a trading profit of £24,702, and a disposable balance of £20,062. A 6 per cent. dividend on the preference shares, and one of 10 per cent. on the ordinary, are proposed, placing £8,000 to reserve, and carrying forward £6,877. The debenture issue of £20,000 was repaid in December last. The directors refer with regret to the death of Mr. G. A. Grindle, the company's consulting engineer, who, it will be remembered, was lost in the wrecked *Hilda*. A contribution to provision made for his widow and family has been set apart out of the year's profits. Last year the ordinary dividend was at the rate of only 8 per cent.

W. T. Henley's Telegraph Works Co., Ltd.—The directors have declared an interim dividend on the ordinary shares at the rate of 10 per cent. per annum, less income-tax, for the half-year ending June 30th last, payable September 1st. An interim dividend on the preference share at the rate of 4½ per cent. per annum will also be paid on the same date. The dividend was at the same rate last year.

South Metropolitan Electric Light and Power Co., Ltd.—The transfer register for the 7 per cent. cum. preference shares will be closed from August 18th to 31st, both days inclusive, for the preparation of dividend warrants for the half-year to June 30th last.

Continental.—BRUSSELS.—La Société Force Eclairage par l'Electricité, of Brussels, is declaring a dividend of 5 per cent. for the last financial year.

PARIS.—The balance-sheet of La Compagnie Electrique des Tramways de la Rive Gauche de Paris for the last financial year shows a loss of £32,664.

MARKET QUOTATIONS.

Wednesday, August 8th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£15	..
a Benzole (90 %)	per gal.	10½d.	..
a ,, (50 %)	per gal.	10d.	..
a Copper Sulphate	per ton	£26	..
a Lead, Nitrate	per ton	£28	..
a ,, White Sugar..	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	5½d.	..
a Potash, Caustic (75/80 %) ..	per ton	£20	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	200/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks ..	per lb.	2¾d.	..
a ,, Cyanide	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£160	..
b ,, Wire, in ton lots ..	per ton	£191	..
b ,, Sheet, in ton lots ..	per ton	£177	..
b Babbitt's metal ingots	per ton	£43 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	9d.	..
c ,, Tube (brazed)	per lb.	10¼d.	..
c ,, ,, (solid drawn).. ..	per lb.	9¾d.	..
c ,, Wire, basis	per lb.	9¼d.	..
c Copper Tubes (brazed)	per lb.	1/-	..
c ,, ,, (solid drawn) ..	per lb.	1/-	..
g Copper Bars (best selected) ..	per ton	£97	£2 inc.
g Copper Sheet	per ton	£97	£2 inc.
g ,, Rod	per ton	£97	£2 inc.
e ,, (Electrolytic) Bars ..	per ton	£92	..
e ,, ,, Sheets ..	per ton	£104	..
e ,, ,, Rod ..	per ton	£95	..
e ,, ,, H.C. Wire	per lb.	11d.	..
f Ebonite Rod	per lb.	8/8	..
,, Sheet	per lb.	8/-	..
n German Silver Wire	per lb.	1/7	..
h Gutta-percha, fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/0½ to 5/2½	..
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	52/-	1/6 inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£17	dec.
g ,, ,, Sheet	per ton	£19	dec.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot	£7	5/- dec.
d Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/8	..
p ,, rolled bars & rods	per lb.	1/1½ to 1/8	..
p ,, ,, strip & sheet	per lb.	1/4	..
o Platinum	per oz.	nominal	..
e Silicium Bronze Wire	per lb.	1/- to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
,, ,, in bars		£15 to £40	..
g Tin, Block (English)	per ton	£180 10 to £181 10	£9 inc.
n ,, Wire, Nos. 1 to 16	per lb.	2/2	..
p White Anti-friction Metals—			
"White Ant" brand	per ton	£46 to £70	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£32	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Lanarkshire Tramways Co.—The report of the company for the half-year to June 30th last states that the receipts were £23,042 and the expenses £12,742, less interest on loans £326, interest on debentures £608, interest on new issue of 4,300 shares £33, and contributions payable to local authorities £529; and adding the balance brought forward, £898, there is a balance of £9,700. The directors recommend a dividend at the rate 5½ per cent. per annum for the half-year ended June 30th, 1906, on the shares issued prior to 1906, carrying forward £2,984. The directors decided in May last to proceed with the extension to Cambuslang, and the construction work is being quickly proceeded with, it being anticipated that the line will be ready for the Board of Trade inspection in a few weeks. The company has paid during the half-year £500 to the burgh of Motherwell towards the cost of the reconstruction and widening of Clyde Street Bridge.

STOCKS AND SHARES.

Tuesday Evening.

Something like a score of fluctuations have occurred in the follow-price-lists since we last wrote, but the period which has elapsed has been covered by the holidays, and consequently there is little of consequence, in the matter of news, to put on record. The Stock Exchange rather hangs upon the money market for the time being, gold being required, as usual in the autumn, for home and American use in connection with movements of crops and other things. The holiday month notwithstanding, there is a fair amount of quiet investment in progress. All the English railways have declared their dividends, and although the announcement of the three important trade lines are considered disappointing, it is indisputable that the Home railway companies are doing very well.

City and South London stock rose to 47½, at which stock changed hands, but the price fell subsequently to 46. Central Londons have also been better, causing stock to come on offer at once, and the price is unaltered on the week. Metropolitan Consolidated is 65½, and Districts are 24: the latter pays 30s. per cent. on its 4 per cent. Debenture stock, the money being derived more from rent than traffics.

Electricity Supply shares are certainly recovering. Business in them is still very quiet, but not so much confined to the selling side. Accordingly it takes a quite small inquiry to make prices better. Charing Cross and Strand Preference are again ⅛ firmer, and at 4½ they pay the round 5 per cent. on the money. Edmundson's are also better, the Ordinary and Preference both rising ⅛, and the Urbans have not moved. South Londons recovered their earlier weakness, and are up again to 3, but Westminsters continue on the down grade, another fall of 5s. taking them to 10¼.

Not one movement of significance has occurred in the Telegraph market. Amazon Ordinary are up a further 5s. at 3⅜, and the Debentures show a couple of points rise. In the Anglo-American group, Anglo "A" lost ¼ in the daily "bull" v. "bear" battle. Beyond these the changes are not worth mentioning. In the Telephone division National First Preference are 10s. easier upon the computations as to their ultimate value. United River Plate Telephone are good at 7¼, and the Debentures advanced a little.

British Westinghouse Preference have again slipped back to 35s., business being recorded last Friday at 32s. Traction issues generally are quiet, British Electric Ordinary fell ⅛, but the Preference put on a similar fraction, and so did new Calcutta Trams, the latter upon the necessity to bring the shares nearer to the quotation of the old. Buenos Ayres and Belgrano "A" Preference are down ⅛. Manufacturing descriptions have nothing to distinguish them except ⅛ rise to 6¾ in British Insulated shares, and an advance in 10s. in Telegraph Constructions.

Baker Street and Waterloo Debenture stock stays at 89½, and the maiden report of the company (since the date of the line's running) shows that at present the profits are not enough to meet the interest on the Debenture stock. It would, of course, be rash to infer from this that the line may not do much better when its facilities become better known. London Motor Omnibus (Vanguard) shares are weak at 25s., which is but a poor welcome to the suggestions current as to possible working agreements, or amalgamation, with the London General Omnibus Company. We have heard nothing fresh in the Stock Exchange with regard to the American undertaking that is said to be coming to swamp London streets with electric 'buses in September. By the way, the opening of the Hastings and District Electric Tramways for Sunday traffic was a brilliant success, but, of course, the start has been made upon one of the most favourable Sundays in the whole of the year.

Delhi Electric Tramways and Lighting Co., Ltd.—The statutory meeting of this company was held on the 2nd inst. at Winchester House, Old Broad Street, Colonel Sir Buchanan Scott, K.C.I.E., presiding. The chairman stated that the allotment was made on May 23rd, when 100,000 6 per cent. preferred and participating shares of £1 each were allotted. The contractors were actively proceeding with the work, and orders had been placed for the bulk of the materials and plant. No time would be lost in completing the construction, which the board trusted would be about July 1st next, when the company would have reached the revenue-earning stage as regarded the tramway. The lighting installation, which had been gradually growing since it was erected some three years ago, might be expected to show a more rapid growth in the near future. In a progressive city like Delhi, with a population of about 200,000 inhabitants, with seven important railway systems and an eighth under construction, there must be great scope for an enterprise of this sort, and no effort would be spared to make the company a success.—*Financial News.*

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations July 31st.	Closing Quotations Aug 7th.	Business done week ended Aug 7th, 1906. Highest	Lowest	Rise + or Fall −
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3¼ — 3⅜	4¼ — 4	71/8	..	+ ¼
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	83 — 85	85 — 90	..	..	+2
702,600	Anglo-American Telegraph	Stock	60/6	61s.	23%	3½%	65 — 67 xd	65 — 67	65¾	..	..
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5½%	6 %	111 —112 xd	111 —112 xd	112	111½	..
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	½%	21⅛ — 21⅜ xd	21⅜ — 21⅝	21⅞	21½	— ⅛
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	8 %	7⅞ — 7¾ xd	7⅞ — 7¾xd	..	..	..
1,932,856£	Commercial Cable Stng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	97½ — 99¼	97½ — 99½	98¼	98⅜	..
16,000	Cuba Telegraph	10	6¼%	10 %	5 %	5 %	8¼ — 9	8¼ — 9	8¼	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 %	8½ — 9½	8⅝ — 9½	..	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..
60,710£	Direct United States Cable	20	8½%	8 %	8½%	4½%	15¼ — 16 xd	15¼ — 16	15⅞	15⅜	..
65,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99½ —101½	99½ —101½	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	142 —145 xd	142 —145	144½	143	..
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	89 — 91	89⅝ — 91⅝	91½	90¼	+ ½
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	107 —109	107 —109	108	..	..
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	14 — 14½	14 — 14½	14⅝	..	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	106 —108	105 —107 xd	..	..	..
300,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1939	100	4 %	4 %	4 %	4 %	100 —102	99 —101 xd	99	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5s%	5s%	5s%	10⅞ — 11¼	10⅞ — 11 xd	10⅛	10⅜	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜ — 14⅝	14½ — 14⅝xd	14⅝	14⅛	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	88 — 40	88 — 40	39¼	38½	..
37,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99½ —101½	99½ —101½	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	58 — 60	58 — 60	58½	58½	..
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	8 %	8 %	4 %	..	⅞ — 1	⅞ — 1	..	..	— ⅛
86,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	..	⅞ — 1	1⅛ — 1⅜	..	..	+ ⅛
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	107 —109 xd	107 —109	108	107½	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	107 —102 xd	107 —109	103½	107½	..
15,000	Do. do. 6 % Cum. 1st Pref. *	10	6 %	6 %	6 %	6 %	11 — 13 xd	10½ — 11½xd	11¼	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10 — 12 xd	10 — 12 xd	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5½ — 5⅝ xd	5⅞ — 5⅛	5⅛	5⅛	— ⅛
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	97 — 99	97 — 99	98½	98	..
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	102 —104	102 —104	103	102⅜	..
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6⅛%	6⅛%	7⅛%	1⅛ — 1⅛	1⅛ — 1⅛	26/3	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	6 %	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	97 — 99	97 — 99	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	5 %	7¼ — 7⅜	7¼ — 7⅜	..	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	100 —103	101 —104	..	..	+1
3,201	Submarine Cables Trust	Certs.	6 %	6 %	6 %	6 %	127 —130	129 —132	..	..	+2
70,000	United River Plate Telephone	5	7 %	8 %	8 %	8 %	6⅞ — 7⅛	7 — 7⅛	..	..	+ ⅛
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	108½—111½	109 —112	..	..	+ ⅛
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9¼ — 10	9¼ — 10	..	..	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	Nil	⅜ — ⅝	⅜ — ⅝	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 — 103	100⅜—103⅜	102	..	+ ⅛
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14¼ — 14⅝	14⅜ — 14⅝	14⅝	..	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	.. — ..	.. — ..	..	..	..
568,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —106	103 —106	103	103⅝	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	+ ⅛
24,563	Do. do. 6 % Cum. 1st Pref.	10	7 % *	7 % *	6 %	5 %	6 — 7	6½ — 6⅞	..	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	4¼ — 5¼	4¼ — 5¼	..	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	8 %	6⅛— 7⅛	6⅛— 7⅛	7⅛	6⅛	..
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	6⅛— 6	6⅛— 6¼	6⅛	5⅛	+ ⅛
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	138 —141	138 —141	140	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	102 —104	102 —104	..	..	..
800,000	Babcock & Wilcox, 1 to 530,000	1	..	17 %	20 %	20 %	3⅜ — 4	3⅜ — 4	..	..	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1¼ — 1⅜	1¼ — 1⅜	..	..	..
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	3¾ — 4	3⅜ — 4	3¼	..	..
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	6 — 6¼	6 — 6¼	..	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5 — 5¼ xd	5 — 5¼	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	4 — 4¼	4 — 4¼	..	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	101 —105	101 —105	..	..	..
300,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	117 —120	117 —120	119	118½	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	107 —110	108 —111	109½	109	+1
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	105 —108	105 —108	106⅜	106	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103 —105	103 —105	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
133,301	British Electric Traction	10	3 %	3 %	3 %	3 %	5⅜ — 5⅞	5½ — 5⅝	5½	..	— ⅛
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	8⅜ — 9⅛	8¼ — 9¼	9⅜	8⅞	+ ⅛
4,415,422£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	109 —112	109 —112	111⅛	111	..
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	89 — 92	89 — 92	90½	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6⅞— 6⅞	6¾ — 7	6⅞	..	+ ⅛
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝— 6 xd	5⅝ — 6 xd	..	..	..
600,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅜ — 2⅛	1⅜ — 2	..	..	— ⅛
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	77 — 83	77 — 83	78	77½	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	9/— 11/	9/— 11/	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	5/— 7/	5/— 7/	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 84	82 — 84	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3⅛ — 3½	3⅛ — 3¼	67/6	..	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	— ⅛
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	4⅜ — 4⅝	4⅜ — 5⅛	..	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	104 —106	104 —106	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —106	..	..	+ ⅛
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	8 — 8⅛	8 — 8⅛	..	..	..
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	+ ⅛
350,000	Do. 4½ % 1st Deb. Stock	100	..	..	4½%	4½%	103 —106	103 —106	..	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	10⅛ — 11⅛	10⅛ — 11⅛	..	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	108 —110	109⅜	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %	⅞ — 1	⅞ — 1	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1⅛— 1⅜	1⅛— 1⅜	..	..	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	95 —100	95 —100 xd	..	..	..
1,939,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	86⅞	..	..
530,316	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	73 — 76	73 — 76	75	74½	..
480,000	City and South London Railway	Stock	3½%	2½%	2½%	1¼%	45 — 47	45 — 47	47⅛	46⅛	..
85,000	Crompton & Co., Nos. 1 to 85,000	3	5 %	2½%	2½%	2½%	1⅝ — 2	1⅝ — 2	..	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	95 — 98	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
¶ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations July 31st.	Closing Quotations Aug. 7th.	Business done week ended Aug. 7th, 1906. Highest	Lowest.	Rise + or Fall −
260,000	Dick, Kerr & Co., 1 to 260,000	£1	..	..	10 %	..	1¼ — 1⅛	1¼ — 1⅛	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	6 %	6 %	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½%	6 %	6 %	14¼ — 15¼ xd	14¼ — 15¼	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14 — 15 xd	14 — 15	..	..	..
800,000	Do. 3½ % "A" Debs.	100	..	3½%	3½%	3½%	96 — 98	96 — 98	..	..	..
800,000	Do. 3½ % "B" Deb. Stock	100	..	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £3 pd., 1 to 99,261	£	Nil	Nil	2s 6d	..	1⅜ — 1⅝	1⅜ — 1⅞	32/9	..	..
17,189	Do. "A" shares, 01—017,189	£	Nil	Nil	2s 6d	..	2½ — 3	2½ — 3	..	..	..
344,023	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..
100,000	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	£	6 %	4 %	Nil	Nil	⅝ — ⅝	⅝ — ⅝	..	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	£	7 %	7 %	7 %	7 %	1⅞ — 2⅛ xd	1⅞ — 2⅛	40/-	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	86 — 89	86 — 89	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9 — 9½	9 — 9½	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	93 — 97	93 — 97	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3⅛ — 3⅜	3¼ — 3⅜	..	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10 — 11	10 — 11	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	101 —102	101 —102	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	£	20 %	15 %	15 %	15%	12 — 13	12 — 13	12⅛	12⅜	..
200,000	Do. do. 4½ % Pref.	£	4½%	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
41,978	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	..	..	..
108,022	Do. do. Scrip. All paid	..	..	..	..	..	107 —109	107 —109	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	£10	10 %	10%	5 %	10%	17 — 18	17 — 18	..	..	..
37,500	†Liverpool Overhead Railway, Ord.	£10	1½%	1⅜%	1½%	Nil	1½ — 1⅝	1½ — 1⅝	..	..	..
10,000	† Do. do. Pref. £10 paid	£10	5 %	5 %	5 %	5 %	4⅜ — 6½	4⅜ — 6½	..	..	..
600,070	London United Trams (1901), 1 to 50,007	£10	..	8 %	6 %	8 %	8 — 8½	8 — 8½	8⅛	8⅛	..
399,930	Do. do. 60,008 to 100,000 (£6 paid)	£10	..	8 %	6 %	8 %	4 — 5	4 — 5	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	£10	..	5 %	5 %	5 %	8½ — 8¾	8½ — 8¾	8⅞	8⅝	..
1,231,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	93 — 96	93½ — 96½	95	94½	+ ½
314,016	Metropolitan Electric Trams, Defd.	£1	Nil	Nil	Nil	3 %	⅛ — ¼	⅛ — ¼	..	..	..
500,000	Do. 5 % Cum. Pref.	£1	5 %	5 %	5 %	5 %	1⅛ — 1⅜	1⅛ — 1⅜	17/6	..	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	100 —102	100 —102	..	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	£	..	..	6 %	6 %	4⅞ — 5⅛	4⅞ — 5⅛	5⅛	..	..
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	6¾ — 7¼	6¾ — 7¼	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	100 —103	100 —103	..	..	..
87,850	Telegraph Construction and Maintenance	£12	20 %	20 %	15 %	15 %	32½ — 34½	33 — 35	34½	33	+ ½
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
8,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	90 — 92	90 — 92	..	..	..
540,000	Waterloo & City Railway, Ord. Stock	100	3¾%	3¾%	3¾%	3¾%	100 — 103	100 —103	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	£	8⅓%	3 %	Nil	Nil	1 — 1½	1 — 1½	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	£	..	6 %	Nil	Nil	2⅜ — 3½	2⅜ — 3½	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	77 — 82	77 — 82	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	£	..	5 %	5⅝%	4 %§	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	£	8 %	10 %	10 %	10 %	8 — 9	8 — 9	..	..	..
10,623	Do. do. 7 % Cum. Pref.	£	7 %	7 %	7 %	7 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..
800,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..
80,000	Charing Cross and Strand Electricity Supply	£	10 %	8 %	8 %	5 %	4 — 5	4 — 5	..	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	£	4½%	4½%	4½%	4½%	4⅛ — 4⅜	4¼ — 4⅜	87/6	..	+ ⅛
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	£	4½%	4½%	4½%	4½%	3⅞ — 4⅛	3⅞ — 4⅛	..	..	..
40,000	Do. do. 1903	£	..	4½%	4½%	4½%	3⅞ — 4⅛	3⅞ — 4⅛	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
44,486	Chelsea Electricity Supply, Ord.	£	4½%	5½%	6 %	6 %	5¼ — 5⅜	5¼ — 5⅜	..	..	..
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —108	106 —108	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10 — 10⅜	10 — 10⅜	10⅜	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11½ — 12⅛	11½ — 12⅛	11⅞	..	..
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	124 —125	124 —125	..	..	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	101⅛	101⅜	..
40,000	County of Durham Electrical Power, Ord.	£	4 %	4 %	£3 7 0	4 %	2⅛ — 3⅛	2⅛ — 3⅛	..	..	..
50,000	Do. do. 5 % Pref.	£	5 %	5 %	5 %	5 %	5 — 5⅜	5 — 5⅜	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	7⅞ — 8⅛	7⅞ — 8⅛	8⅛	..	..
80,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11½ — 12⅛	11½ — 12⅛	11⅝	..	..
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	106 —109	..	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	£	7 %	7 %	7 %	4 %	3½ — 3⅝ xd	3⅜ — 3⅝	72/6	..	+ ⅛
80,000	Do. do. 6 % Cum. Pref.	£	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	5⅛	..	+ ⅛
300,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	100 —103	100 —103	101	..	..
10,000	Folkestone, 1 to 10,000	£	..	5½%	5½%	5½%	5⅛ — 5⅜	5⅛ — 5⅜	5	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	£	..	..	..	5 %	5 — 5⅛	5 — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	99 —102 xd	99 —102	..	..	..
13,000	Hove, 1 to 13,000	£	..	8½%	8½%	9 %	7⅞ — 8⅛	7⅞ — 8⅛	8	..	..
10,000	Do. New (£6 10s. paid)	£3	..	8½%	8½%	9 %	6⅝ — 7	6⅝ — 7	..	..	..
87,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	99 —101	99 —101	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	£	10 %	12%	12 %	10 %	9⅞ — 10⅜ xd	9⅞ — 10⅜	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	97 —100 xd	97 —100	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	£	Nil	Nil	3 %	4 %	2 — 2⅛	2 — 2⅛	..	..	..
60,000	Do. do. do. 6 % Pref.	£	6 %	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	..	..	..
574,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	97	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	£	7½%	8½%	10 %	10 %	8 — 9	8 — 9	8⅜	8⅛	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	£	4½%	4½%	4½%	4½%	5⅝ — 5⅞	6¼ — 6⅜	6⅜	5⅛	— ⅛
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	109 —113	109 —113	..	..	..
220,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	94 — 96	94 — 96	..	..	..
220,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	£	..	8 %	8 %	8 %	7⅞ — 8 xd	7⅞ — 8	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	£	..	5%	5 %	5 %	5⅝ — 6⅛ xd	5⅝ — 6⅛	..	..	..
10,852	Notting Hill Electric Lighting	£	6 %	6 %	7 %	7½%	13½ — 14½	13½ — 14½	..	..	..
64,000	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	£	..	6½%	7 %	7 %	6⅝ — 6⅞	6⅝ — 6⅞	..	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£	14½%	14½%	14½%	12½%	10½ — 11½ xd	10½ — 11½	10⅝	10⅝	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	£	7 %	7 %	7 %	7 %	6⅞ — 7⅛ xd	6⅞ — 7⅛	..	..	..
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£	2½%	2½%	2½%	2½%	2 — 2⅛	2 — 2⅛	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	74 — 75 xd	74 — 78	..	..	..
65,000	South London Electricity Supply, Ord.	£	12½%	8 %	4 %	4 %	2⅜ — 2⅝	2⅜ — 2⅝	..	..	+ ⅛
103,700	South Met. Elec. Lt. & Power (Ord.	£	Nil	Nil	Nil	2½%	⅜ — ⅝	⅜ — ⅝	..	..	..
85,368	*(Late Blackheath and Greenwich* (7 % Pref.	£	Nil	7 %	7 %	7 %	1⅝ — 1⅞	1⅝ — 1⅞	..	..	..
148,292	*Dist. E.L.Co.)* (4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
50,000	Urban Electric Supply, Ord.	£	5 %	5 %	5 %	5 %	3½ — 4	3½ — 4	..	..	..
80,000	Do. do. 5 % Cum. Pref.	£	5 %	5 %	5 %	5 %	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	100 —102	100 —102	..	..	..
110,000	Westminster Electric Supply, Ord.	£	12 %	13½%	14 %	18 %	10 — 11	9⅞ — 10⅜	10⅛	..	— ⅛
28,151	Do do. 4½ % Cum. Pref. (Originally 5 %—Red. to 4½ % from 31st Dec., 1905.)	£	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..

Shares not officially quoted:—Mackay Companies, ord., 76—78 Pref. 74—76.

† Unless otherwise stated all shares are fully paid. § Interim dividends.

(Bank rate of discount 3½ per cent. June 21st. 1906).

THE FARADAY SOCIETY.

The Fixation of Atmospheric Nitrogen in Electric Arcs.

An extra meeting of the Faraday Society was held on July 2nd to enable Prof. Birkeland, of Christiania, who had been spending a few days in London, to describe to the members the present position of the Birkeland-Eyde process for making nitrates from the air. The meeting, which was held at the Society of Arts, attracted a large audience, and was presided over by Prof. Silvanus Thompson.

It is now just six years ago since the attention of the world was drawn by Sir William Crookes, in his presidential address to the British Association, to the fact that the existing native supplies of saltpetre were being rapidly exhausted, and he then pointed out, in grave and measured language, that, unless artificial means of supplying this great wheat fertiliser were discovered, there was every likelihood of Mother Earth's failing, at some not far distant date, to realise her primary duty of feeding her own children. Fortunately, Nature has supplied in bountiful plenty the raw materials required for building up fertilising nitrates; out of the air over each square mile of the earth's surface can be got more nitrogen than is to be found in all Chili, and within the last few years scientific men of first-rate ability, Prof. Birkeland among their number, have attacked the great problem with extraordinary skill and energy, so that, whatever difficulties may have to be overcome in creating on a commercial scale a nitrate industry sufficiently vast to supply the whole world with its daily bread, one can safely say, with Prof. Birkeland, that we have no longer any reason to fear the near exhaustion of the world's stock of fixed nitrogen. Prof. Birkeland is well known for his important work on the aurora borealis and on the deflection of certain cathode discharges; it is of interest to note how these purely scientific investigations have been the means of leading up to an important industrial process.

The nitrate problem has been attacked in two distinct ways—both equally dependent upon the methods of the electrochemist. Frank and Caro, of Berlin, have shown that at a red heat the carbides of the metals of the alkaline earths absorb the nitrogen supplied to them, forming metallic salts of cyanamide, which can be introduced directly into the soil as a fertiliser. The second method, with which we are here more directly concerned, is based on the discovery made originally by Priestley and Cavendish, two and a quarter centuries ago, that oxygen and nitrogen may be made to combine when electric sparks are passed through them. The method has since been studied by Spottiswoode and Dewar in 1880, and by Crookes in 1892, but it was Rayleigh in 1897 who first used electric flames, literally so called, for carrying out the oxidation of nitrogen on a fairly practical (though not commercial scale) in his experiments that led up to the discovery of argon, and it was these

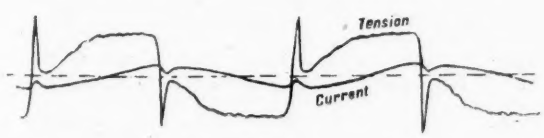


Fig. 1.

experiments, in which a flame absorbing as much as 1 H.P. was employed, which showed that with high tension electric arcs nitrogen might be fixed in an economical manner, and possibly even on an industrial scale. Since that date many experimenters have been at work, notably Kowalski and Moscicki in Freiburg (working at enormously high voltages and frequencies) and Bradley and Lovejoy in the United States, trying to apply the method for the wholesale synthetic production of nitric oxide from air, but technical difficulties of various kinds failed to be surmounted by the methods used by them, and all the processes, excepting that of Birkeland and Eyde, are now, unfortunately, of historic and scientific interest only.

The essence of the electrical side of the problem consists in the production of a stable and practical form of high-tension arc of such a nature that the cooling of the combined gases can take place so rapidly that no opportunity is afforded for them to dissociate, which would be the case if they were cooled slowly from the temperature of the arc-flame at which the combination takes place; the arc, in fact, must be of the greatest possible length and the smallest possible section, in order that a maximum volume of air may be brought into contact with the flame surface. Bradley and Lovejoy attained the required conditions by dividing up an arc of great energy into an innumerable series of small arcs, a method which eventually proved impracticable. Prof. Birkeland, influenced doubtless by his work on the magnetic deflection of cathode discharges, places his alternating-current arc of 5,000 volts pressure and frequency 50, equatorially between the poles of a powerful electro-magnet. The short arc (8-10 mm.) thus formed is equivalent to an easily movable and ductile current conductor, and it is repelled across the strong magnetic field, which is of 4,000 to 5,000 lines per sq. cm. in intensity, with enormous but decreasing velocity, its roots travelling along the electrodes away from their extremities. While its length, and, therefore, its resistance thus increase, the voltage of the arc is proportionally heightened, assuming the strength of the current to be regulated by an inductive resistance in series with the flame, until a new arc forms at the points of the electrodes and the longer outer arc is extinguished. Under the proper conditions of magnetisation and length of arc, one arc only, as shown by oscillograph records reproduced in the paper (see fig. 1), is formed at each reversal of the current, and the appearance of the arcs when an alternating current is used, so that all the positive arcs move in one direction and the negative in the reverse, is that of a complete, luminous, circular disk of flame (see fig. 2, which is a reproduction of a photograph of a 250-H.P. flame). The elec-

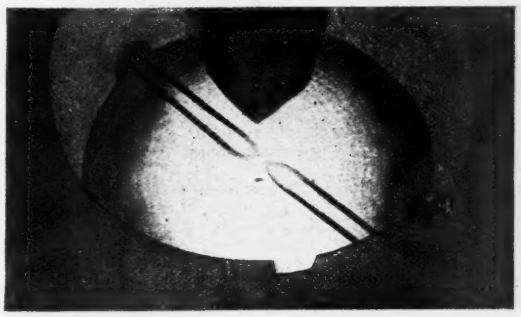


Fig. 2.

trodes, which have to be removed for simple repair every 300 hours (at a cost of only 15 minutes' time), are made of copper tubing 15 mm. in diameter, bent double so as to allow of water-cooling, which, by the way, wastes only 7·5 per cent. of the total energy supplied to the arcs. The electro-magnets absorb from 0·5 to 0·7 of the total energy.

The author promises a complete investigation, using a duplex oscillograph, of the current and voltage curves in order to throw light on various questions of great theoretic interest.

The disk flame produced as described is enclosed in a special metal furnace lined with firebrick and containing a very narrow fire-chamber, through the central region of which air is driven by a Roots blower, as shown diagrammatically in fig. 3, which represents the newest type of furnace. In general appearance the furnaces are not unlike ordinary modern enclosed dynamo machines. At the Notodden Works of the Norwegian Nitrogen Co. there are three such furnaces, each absorbing 500 KW., and treating between them 75,000 litres of air per minute. They burn with remarkable steadiness and require hardly any attention.

After passing through the furnaces, the air contains about 1 per cent. of nitric oxide, and its temperature is 700° C., in spite of the enormous temperature of the disk flame. It discharges its superfluous heat first into a steam boiler, the steam of which is employed

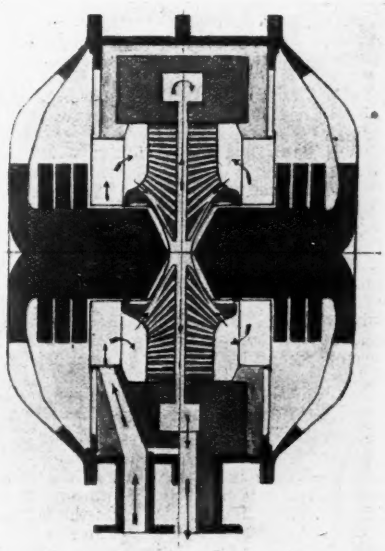


Fig. 3.

at a later stage of the process, and then into a cooling apparatus, which it leaves at a temperature of only 50° C. to become further oxidised in oxidation chambers, so that the nitric oxide becomes peroxide. The mixed gases then pass to the absorption towers, of which there are two series of five towers each, and the product finally emerges as 50 per cent. nitric acid. The unabsorbed nitric fumes from the fourth of the towers are led into a fifth tower

through which trickles milk of lime; this converts the rarefied fumes into a mixture of calcium nitrate and nitrites, which in turn is completely oxidised by means of nitric acid. This dilute nitrate lye, mixed with the bulk of the nitric acid yielded by the fourth absorption towers, reacts on limestone, and is converted into the final product of the works, normal or basic calcium nitrate.

The yield of the furnaces at Notodden is on a very moderate estimation, and based on most careful operations, stated to be 500 kilogrammes of anhydrous nitric acid per kilowatt-year, but Prof. Birkeland has obtained far better individual results than even this excellent output. The cost of the raw material, practically only limestone, is, of course, almost negligible, while hydro-electric power in Norway, although 25s. per E.H.P.-year is paid for it at Notodden, can be generated for less than half that figure. The result is a veritable triumph for all concerned; the nitrate can be manufactured for £4 a ton, while the present market price of the equivalent weight of fixed nitrogen is practically double that amount.

Before the estimates for the new factory of 30,000 H.P. now being built at Notodden were finally approved, a special Commission, on which were included experts in every branch of technology concerned with the electric nitrate process, visited the present works at Notodden and the experimental furnace at Arendal about a year ago, and made an exhaustive series of tests in order to determine as exactly as possible the data on which to base the dimensions and capacity and arrangement of the various parts of the new works. The Commission consisted of MM. Grandeau, Schlœsing, Jurrettini, Otto Witt and Prof. Silvanus P. Thompson, the chairman at the Faraday meeting. The new works will derive their power from Svaelgos, 5 kilometres distant, and each furnace will absorb 750 KW. normally and 850 KW. during flood time. The inclusive cost of the furnaces is £1,000, but it is believed that with the experience now at the disposal of the company future furnaces of 2,000 KW. will be capable of erection at a cost of not more than about £1,200. Of the 30,000 H.P. delivered at the works, not more than 1,000 H.P., or about 3 per cent., will be used for the auxiliary purposes of the factory, so that the general efficiency of the plant, which appears to have been designed with thought, care, and scientific knowledge of the highest order, will be exceptionally great. We await with the keenest interest the first published results of this unique undertaking, which, without exaggeration, may be said to mark an epoch in the applications of electro-chemical methods to the solution of industrial problems.

Not the least suggestive part of Prof. Birkeland's paper, in spite of its being somewhat fragmentary in form, is where he deals with some theoretical points connected with the electric oxidation of nitrogen. A brief reference to these, which lie within the scope of the work of the physical chemist rather than that of the electrical engineer, must suffice for the present. Calculations of this nature are beset with difficulties, because the whole question, considered from the thermo-chemical standpoint, depends on the equilibrium of nitrogen, oxygen, and their compounds under the temperature conditions obtaining in the arc flame, and these are unknown. Prof. Birkeland has tried to arrive at some estimate of the temperature by making ingenious measurements of the width of arc-flame filaments, but no very definite conclusions are arrived at, and finally the output is calculated for various assumed temperatures from a formula of Nernst's, and compared with that obtained from a very careful trial run made at Arendal with a 300-KW. furnace, various assumptions, of course, being made. Finally, after allowing for the length of time the maximum temperature is effective, Prof. Birkeland arrives at an average temperature of 3,200° C., but he recommends that a higher temperature be aimed at in practice, for there is a maximum theoretical output at 5,200° C. The calculation, however, may be further complicated by the fact that it is not sufficient to consider merely thermo-chemical considerations, but that the ionisation which, of course, exists in arcs, as shown by J. J. Thomson, may also be a potent factor in determining the state of chemical equilibrium in the gaseous mixtures. This consideration is a matter of extreme interest, and we trust that Prof. Birkeland will follow it up and will carry out the comparison that he himself suggests of the concentration of NO formed when air is ionised, say, by radium, and that formed when air is ionised only by means of heat. This comparison should throw considerable light on the mechanism of oxidation in the arc flame, and might prove of great utility in determining the conditions necessary for the highest possible efficiency.

The Electric Smelting of Canadian Iron Ores.

A paper on this subject by Dr. Eugene Haanel, dealing with the purely technical aspects of the experiments recently made at Sault Ste. Marie by the author on behalf of the Canadian Government, the general results of which have already been made public, was read by Mr. F. W. Harbord, who was the metallurgist to the Canadian Commission of 1904. The experiments were designed for the purpose of finding out whether the results of the rather crude tests made at La Prez and Livet on electric pig-iron smelting could be improved upon working under more ideal conditions, and whether, in particular, the special conditions obtaining in Canada were favourable to the development of a native industry, using thermo-electric methods. The answer to the first question is a decided affirmative. The mean efficiency provisionally adopted by the Commission was 7 to 8 tons of pig per 1,000 E.H.P.-years. The Sault Ste. Marie experiments have shown that under normal conditions the output may be increased to 11·5 tons, while with an improved furnace of 1,500 E.H.P. capacity, an output of 12 tons is anticipated.

The furnace was of the Héroult type; it absorbed 5,000 amperes at 35 to 40 volts (power factor 0·919), being fed from a transformer of 225 KW. capacity. The official experiments, of which a selected number are described in detail with full chemical, electrical and thermal data, lasted nearly two months, and during that time 150 casts were made, yielding 55 tons of pig-iron.

The answer to the second series of questions may best be stated in the tabulated form given by Dr. Haanel.

1. Magnetite (which is the chief Canadian ore) can be as economically smelted by the electro-thermic process as hematite.

2. Ores of high sulphur content not containing manganese can be made into pig-iron containing only a few thousandths of 1 per cent. of sulphur.

3. The silicon content can be varied as required for the class of pig to be produced.

4. Charcoal, which can be cheaply produced from mill refuse or wood which could not otherwise be utilised, can be substituted for coke as a reducing agent, without being briquetted with the ore.

5. A ferro-nickel pig can be produced practically free from sulphur and of fine quality from roasted nickeliferous pyrrhotite.

6. The experiment made with a titaniferous iron ore containing 17·82 per cent. of titanic acid permits the conclusion that titaniferous iron ores up to perhaps 5 per cent. of titanic acid can be successfully treated by the electric process.

It would be rash to assert that these few experiments on a comparatively small scale, however admirably carried out, definitely decide once for all that pig-iron may be made from Canadian magnetite, so as to pay a respectable dividend on the capital sunk in the project, and it ought in fairness to be pointed out that in the opinion of many eminent metallurgists electro-thermic pig-iron will eventually not be able to compete with the pig-iron made, say, under the extremely favourable conditions of the Dominion Co.'s great modern blast furnaces, excepting perhaps in districts where freights—or bounties—are determining features. But a good case is undoubtedly made out for further cautious development, and it is most sincerely to be hoped that it may be found possible, without immediately creating in a fit of enthusiasm an inflated and artificial electric smelting industry, still to put the electric method to a fair test under industrial conditions, and further to develop soberly and with due consideration the results of undoubted promise yielded by these experiments of Dr. Héroult and Dr. Haanel.

RAYMOND PHILLIPS'S SYSTEM OF AUTOMATIC TRAIN CONTROL.

We have received from an expert correspondent the following queries regarding this system, and we give below the inventor's replies:—

The description of this system of signalling on engines and partial automatic control of trains, which appears in the issue of the Electrical Review for the 20th ult. is of a most interesting character, and the fact that it is understood to have been approved by the Board of Trade gives it more than ordinary importance. Would it be too much to ask for a few further particulars?

1. By what means is the signalman advised of the disregard of a "danger" signal by the driver, as stated to be arranged for in the first paragraph of the description? What is the character of the "repeater" referred to, and how is the bell rung? Would it be possible to get a diagram showing the arrangements?

2. For what reasons are the semaphore indicators on the engine shown in the "danger" position, when the apparatus controlling them is shown by the illustrations in such positions as will give "line clear" indications?

3. What is the object of causing the "distant" and "home" indicators to be operated simultaneously when the "home" valve lever is operated? To what conditions of railway signalling does this correspond?

4. Looking at the plan, and assuming that the engine is equipped to obtain the signals "distant" and "home" in their proper order when running under normal conditions, *i.e.*, when running engine first, what is there to prevent the "distant" signal tripper on the line from operating the "home" valves and indicator, and the "home" signal tripper on the line the "distant" valves and indicator on the engine when the latter is running tender first?

5. What effects are produced on the indicators by an application of the brakes by the driver by the ordinary means provided for the purpose?

6. Assuming that a striking lever (E or F) is broken and the compressed spring between the jaws acts as it is intended to do and notifies the driver of the defect by raising the indicator affected to danger and by causing the siren or whistle to sound, what is going to take its place for the remainder of the train journey?

The dropping of the weighted lever by the accident will not only raise the indicator to "danger" but will also admit air to the train pipe by the siren or whistle, and will thus apply the brakes to the train. It will, therefore, be necessary for the driver to replace the indicator in the "line clear" position by the use of the three-way cock in order to enable him to release the brakes. For the rest of the train journey the indicator affected would be useless, and might give the driver any number of false indications

when passing signals of the class represented by the broken striking lever. As the indicator would continuously show "line clear," even when approaching or passing a line signal, of the class represented, at "danger" the risk to be run would be considerable.

7. It is perfectly well known that the Board of Trade officials insist upon apparatus intended to repeat the positions of line signals upon the engine being capable of giving a positive "line clear" signal as well as a positive "danger" signal. How is the "line clear" indication given by the apparatus under consideration? As far as the writer can see from the drawings and the description, no positive "line clear" indication is given. The apparatus appears adapted to give "danger" indications only on the engine, and "line clear" is inferred from the absence of "danger" indications.

8. At what speeds has the striking apparatus been tried, and approximately how often have the striking levers been struck, during the two years the North Staffordshire engine has been equipped?

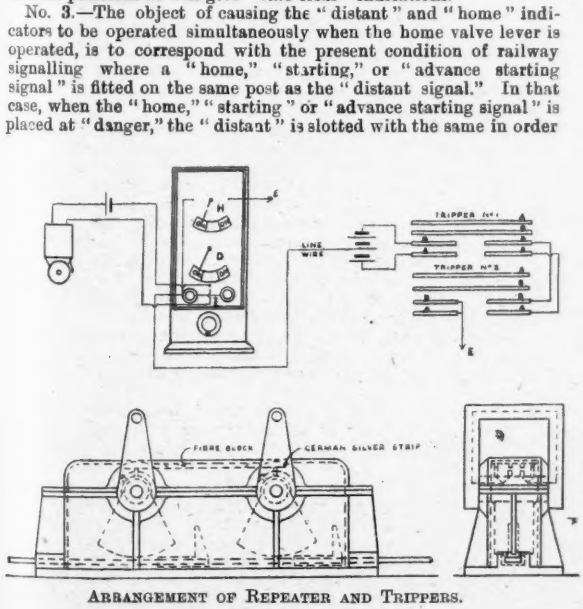
9. What is the approximate cost of equipment (1) per engine; (2) per signal to be indicated?

10. The application of the principle of the Bourdon gauge for the actuation of the indicators is particularly neat. Are the semaphore arms steady in the "line clear" positions when the engine is running at high speeds, and especially over crossings?

In reply to query No. 1.—We enclose a diagram showing the electrical connections of the tripper with the repeater, from which you will observe that, so long as the trippers remain either at "danger" or "line clear" position, the circuit is closed, and consequently the indicators are held up by the magnets. It will be seen from the diagram that the moment the tripper arm is struck by the lever on the engine, the circuit is automatically opened, which consequently causes the indicator to fall, thus showing whether the tripper is fitted at a "distant" or "home" signal. The indicator, in the act of falling, also closes a local circuit, which causes a bell to ring, and such bell continues to ring until the indicator is restored to its normal position by means of the plunger fitted in the repeater. In the end elevation of the tripper, it will be seen that the wire connecting the contacts is carried over the top of the arm internally, so that should the arm be broken, the conductor would also be broken, the current would be cut off, and the indicator pointer would fall to the middle position, which is marked "out of order." The indicator disk would drop, ringing the bell, and the indicator could not be replaced until a new balance weight had been fitted.

No. 2.—It is a misprint [Not ours.—Eds. E.R.] that the semaphore indicators on the engine are shown in the "danger" position, when the apparatus controlling them is shown by the illustrations in such positions as will give "line clear" indications.

No. 3.—The object of causing the "distant" and "home" indicators to be operated simultaneously when the home valve lever is operated, is to correspond with the present condition of railway signalling where a "home," "starting," or "advance starting signal" is fitted on the same post as the "distant signal." In that case, when the "home," "starting" or "advance starting signal" is placed at "danger," the "distant" is slotted with the same in order



Arrangement of Repeater and Trippers.

to comply with Board of Trade requirements, and the same operation is therefore repeated with the indicators in the cab of the engine. We now use one duplex vacuum gauge, in which is fitted a "home" and "distant" semaphore, such semaphores being on one post as just referred to.

No. 4.—It is a matter of arrangement in what position the box containing the mechanism on the engine may be fixed.

At the present time, on the North Staffordshire Railway, the box of mechanism is placed a little out of the centre of the frame, and the trippers on the track are placed in such positions that when the locomotive is running tender first the "distant" or "home" striking levers come in contact with trippers which are fixed on one side of the 4-ft. Should, however, the locomotive be running engine first (in which case the locomotive will be turned round), the "home" or "distant" striking levers respectively come in contact with trippers placed on the other side of the 4-ft. It therefore does not matter whether locomotive runs tender or engine first, as was shown at the demonstration which took place at Stoke-upon-Trent on July 10th, when the locomotive was run in both directions, and it will be seen from the drawing that the striking levers E and F can work in either direction.

No. 5.—No effect is produced on the indicators in the cab of the engine by an application of the brakes by the driver by the ordinary means, or even should the communication cord be pulled by a passenger. This is ensured by means of a check valve, which is placed between the train pipe and the reservoir which works in conjunction with the indicators in the cab of the engine. This check valve serves the purpose of allowing air to be exhausted from the reservoir, but air cannot be admitted into such reservoir from the train pipe, as the check valve stops its passage.

No. 6.—Assuming that a striking lever E or F were broken, it will be seen from the drawing that the gauge indicators affected would immediately go to "danger," and the brakes would be applied. There is also another form of lever used in conjunction with this system which is hollow throughout. Although the patent covers the hollow lever and the lever fitted with a spring, the hollow lever is the one we should propose to put into practice, as it will be readily seen that the hollow lever is directly connected to the train pipe and gauge indicators, so that should such hollow lever be broken or worn away the brakes would be immediately applied, and the gauge indicators placed at "danger." In the event of a broken lever, it is quite true that a driver could use the 3-way cock in order to enable him to replace the mechanism and place the indicator to "line clear" position, but the handle of the 3-way cock being shaped and painted the same as an ordinary semaphore-means that although the driver could use it to place his indicators at "line clear" position, the handle or semaphore fitted to the 3-way cock would show "danger" position, so that if the driver proceeded on his journey without replacing the broken striking lever he would be running against "danger" signals. Before a driver actually gets "line clear" position the brakes must first of all be released, the gauge indicators must show "line clear," and the handle or semaphore fitted to the 3-way cock must also be in the "line clear" position, so that the driver could not possibly get any number of false indications, as your correspondent suggests, when passing signals of the class represented. In addition to this, the signalman would duly have received warning of the approach of the train, and if the driver stopped the train for a few minutes to replace the broken lever, the signalman could not give "line clear" signal to the preceding signal box until such time as the train had passed his section.

No. 7.—We are aware that the Board of Trade officials insist upon apparatus intended to repeat the position of "line signals" upon the engine being capable of giving a positive "line clear" as well as a positive "danger" single. This stipulation has, no doubt, been made due to the fact that in all other systems comprising a locomotive attachment, the question of breakages of the striking lever or other parts has not been provided for, and consequently it is absolutely essential in such systems that a positive "line clear" signal should be given. But in this system, what we claim as an advance on all others is that in case of breakage, a "danger" signal is immediately automatically given and the brakes of the train are applied, and such "danger" signal cannot be cancelled until the broken lever is replaced by a new one. Apart from this, however, it will be noticed from the drawings that the levers on the engine must at all times be in a vertical or striking position, otherwise the arm joining the mechanism would drop and thus indicate to the driver a "danger" signal. The trippers also must be in a vertical or striking position, or the same would be indicated to the signalman by both a *visual* and an *audible* signal; consequently, it is not necessary in this system to provide a positive "line clear" signal other than the gauge indicators being kept at "line clear" position until such time as they are operated by the trippers on the permanent way.

No. 8.—The highest speed attained at the demonstration at Stoke-upon-Trent on July 10th was from 40 to 45 miles per hour. We do not hesitate to express our opinion that although 40 to 45 miles was the quickest pace at the trial, the highest speed would not be any detriment in practice.

It is impossible to arrive at the approximate number of times the striking levers have been struck during the two years the North Staffordshire engine has been equipped, but it has had the ordinary use in practice.

No. 9.—A set of this apparatus consists of an engine attachment, comprising a box of mechanism, and double signal vacuum or pressure gauge for the engine, horn, whistle or siren, special three-way cock, two trippers for a "distant" signal and two for a "home" signal, and one duplex repeater for the signal box, such repeater repeating the condition of the "distant" and "home" trippers respectively. The total cost would be approximately £50 a set, but this is only an approximate price, as, no doubt, in large practice, some economy might be effected.

No. 10.—The semaphore arms of the indicators are perfectly steady in the "line clear" position when the engine is running at high speeds, or when running over crossings. The semaphore arms are also perfectly steady when in the "danger" position, special provision having been made to effect this in the manufacture of the indicators.

The approximate estimate for completely applying the "Raymond Phillips's System of Automatic Train Control" to the entire railway systems of the United Kingdom would be infinitesimally small on the total capital expenditure, and the benefit both to the railway companies and the travelling public would be enormous.

SERIES RUNNING INCANDESCENT LAMPS FOR STREET LIGHTING.*

On May 11th, before the Illuminating Engineering Society of New York, Mr. Francis W. Willcox read a paper entitled "High-Efficiency Incandescent Lamps for Street Lighting."

The author commences his paper by alluding to the advantage of lighting the smaller streets by incandescent lamps, when the higher intensity of arc lighting is not

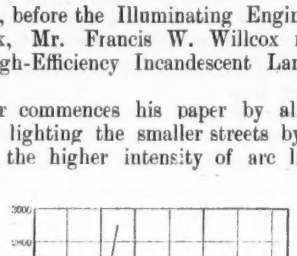


Fig. 1.

required. Lamps run in series on high voltage (2,000 volts and upwards) are recommended.

Until the last three or four years, it is stated, series incandescent lighting has been found far from satisfactory, chiefly for the following reasons:—

1. The lack of suitable and reliable apparatus for automatically maintaining the current constant.
2. The lack of reliable cut-outs in the lanterns.
3. The inefficiency and unsatisfactory nature of the low-voltage lamps required for series working.

The first cause of failure has been overcome, it is stated, by the employment of the constant-current transformer.

Film cut-outs working in the lamp sockets are now found to work perfectly satisfactorily, operating directly a lamp filament breaks.

The most remarkable improvement, however, has been in the use of the new metallised filament, or Gem incandescent lamps, the process of metallising filaments being specially applicable to the short and thick filaments such as are used in the low-voltage high-amperage lamps employed for series working.

Mr. Willcox states that when burning in series on constant current a $2\frac{1}{2}$-watt metallised filament has the same useful life as a $3\frac{1}{2}$-watt ordinary carbon filament.

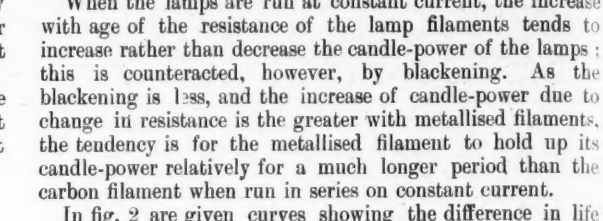
The relation between initial watts per candle-power and useful life is clearly shown in the curves (fig. 1) for the ordinary carbon filament (I), and also for metallised filaments (II). The useful life has been taken as the number of hours' run till the candle-power has become reduced to 75 per cent. of its initial value. It is to be noted that these curves represent results to be obtained with low-voltage lamps run in series on constant current, and are therefore not comparable with the life curves given by other authorities for lamps run on constant pressure.

In the case of ordinary lamps, Mr. Willcox states that about 45 per cent. of the deterioration of the lighting value is due to change of resistance, and 55 per cent. is due to blackening. These figures must, however, not be taken as final, as authorities differ very greatly upon this point.

With the metallised filament, however, the change in resistance accounts for 80 per cent. of the light deterioration, and blackening for only 20 per cent. These figures are intended to apply to lamps run at constant pressure.

When the lamps are run at constant current, the increase with age of the resistance of the lamp filaments tends to increase rather than decrease the candle-power of the lamps; this is counteracted, however, by blackening. As the blackening is less, and the increase of candle-power due to change in resistance is the greater with metallised filaments, the tendency is for the metallised filament to hold up its candle-power relatively for a much longer period than the carbon filament when run in series on constant current.

In fig. 2 are given curves showing the difference in life deterioration of carbon filaments when run on constant pressure and constant current. It will be seen how much



I.—Constant voltage. II.—Constant current, calculated from I. III.—Actual results of tests at constant current (25-c.p. 1·75 a., 3·5 w.p.c.)

Fig. 2.

better the candle-power of the lamps is maintained when run on constant current.

It is a pity that similar curves are not given for the new metallised filament lamps, as these curves would have been very useful to lighting engineers in this country for comparison with the results to be obtained with Nernst lamps. There are very few series lighting systems in this country, and what we would like to have is not so much the life curves of carbon filament lamps, which we know cannot compete with Nernst lamps, but of the new metallised filament lamp which may, perhaps, when run in series, be a competitor of the Nernst lamp.

Mr. Willcox has calculated the cost of lighting with metallised filament 25-c.p. lamps run in series, taking the cost of energy at 1, 2 and 3 cents per unit, and the cost of lamps as 30, 40 and 50 cents each. The results of these calculations are embodied in the curves in fig. 3. The curves show

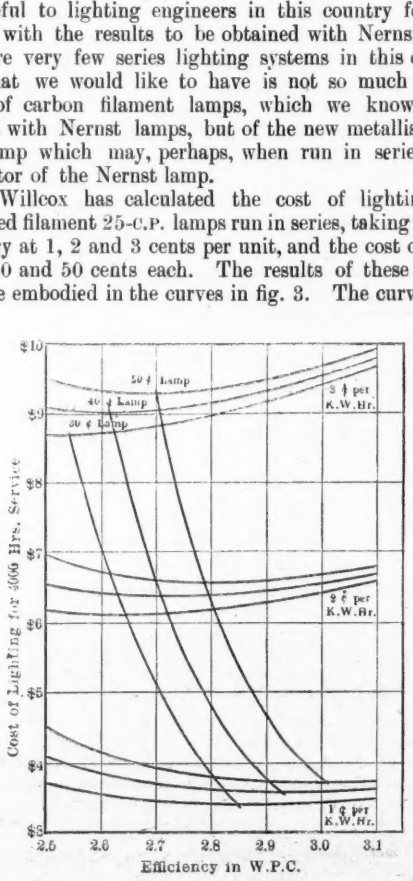


Fig. 3.

at a glance the best starting efficiency to adopt under various conditions as to cost of energy and lamp renewals. The author arrives at the figure 2·7 watts per candle as the best starting efficiency to adopt under average conditions.

* From report in the *Electrical Review* (New York), of June 2nd.

Mr. Willcox recommends the use of lamps taking between 1 and 3 amperes in preference to 5·5 amperes, which appears to be the common practice in the States. The difficulty of making either carbon or metallised filament lamps for the larger current is very great, and the lamps are never so satisfactory as those taking a somewhat smaller current.

It is stated that it is common practice in the States to employ lamps of 30 c.p., such lamps being considered to give, on the average, about the same light as is given by Welsbach burners, with which they have to compete. As we point out in our leading article to-day, the light intensity of the incandescent mantle at all angles below the horizontal falls far short of the maximum value, and the effective value for street lighting purposes is probably not far from 30 c.p. at an angle of 45° under average working conditions. Of course, much lower values are often found due to dirty globes, but this applies also, though not to the same extent, to electric lighting.

In summing up, the author declares in favour of metallised filament lamps, run in series on constant current, taking about 1·75 amperes and giving initially 25 to 30 c.p., the total number of lamps to one circuit being about 100 and the total voltage, with all in series, from 3,500 to 5,500 volts.

Mr. Willcox has also a word in season to say on the advantage of uniformity of illumination, which can best be obtained, leaving out for the moment the question of cost, by using lamps of low candle-power spaced at very frequent intervals.

It is a great pity that Mr. Willcox, in his paper, ignores the existence of the Nernst lamp. A comparison of the life curves of the new metallised filament series-running lamps with those of parallel-running Nernst lamps would have been of great interest to engineers in this country.

THE DEVELOPMENT OF SINGLE-PHASE MOTORS.

By LEONARD J. PUMPHREY.

Direct-current enthusiasts have always claimed that their favourite system of supply possesses an overwhelming advantage, inasmuch as it is the most suitable for motors. Every station engineer, who coveted a day load, was strongly recommended to lay out his distributing network on the direct-current plan, and this arrangement seemed to give every satisfaction for the small distributing systems to which we have been accustomed in this country.

On the Continent and in America, where natural conditions favour, and in some cases even necessitate, long distance transmission schemes, alternating current has generally

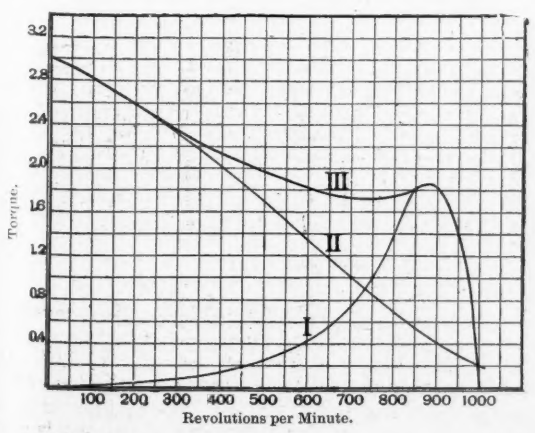


Fig. 1.

been found more satisfactory for transmitting power owing to the high voltage that copper economy demands.

If the electrical industry is to develop in the way that those who are engaged in it hope it will do, one of the first essentials lies in the cheap production of energy. Now, electrical energy to be cheaply produced, must be generated in bulk in large power houses located in favourable situations. This involves, of course, long-distance transmission to the more remote parts of the distributing system, and for this purpose alternating current is being, and will probably be, almost universally employed.

Electrical power having thus been cheaply produced, and distributed by high-tension feeders, the next problem that arises is how it may be most economically utilised. If it should be the case that for power purposes we are depending upon direct-current motors, it follows that costly sub-stations equipped either with motor-generators or with static transformers and synchronous rotary converters must be installed. The interest on the capital charges thus incurred, and the expense of attendance, will obviously militate against keeping down the price per unit at the consumers' terminals. The solution of the difficulty lies in the use of alternating-current motors, and there will certainly arise in this way an enormous demand for alternating motors in the immediate future.

Polyphase motors have many advocates, and have done excellent service in connection with the driving of factories and machinery. At the same time, difficulties in connection with speed regulation and the necessity for three connecting wires are drawbacks, and there will, therefore, be a very great field of utility for single-phase motors. The latter may be roughly divided into (1) motors with constant magnetic field; and (2) motors with alternating magnetic field. In Class 1 we have simply an ordinary alternator used as a motor, which is usually known as a synchronous motor. Owing to the fact that these are not self-starting, they are practically of little value for commercial purposes, except when required to drive very large loads and to run practically continuously.

An over-excited synchronous motor produces a leading current, and therefore, from the point of view of power factor, it is a great advantage to have motors of this type connected on a supply system. Owing to their absolutely constant speed and high efficiency, they are frequently used for driving dynamos and line shafting. In some cases amortisseur circuits have been fitted to the magnet poles, and these prove of great advantage in assisting the motor to keep in step when overloaded.

Passing now to the second class—viz., motors with alternating magnetic field—we find that development of these has taken place along various lines. Broadly speaking, they may be divided into the following types:—(1) Pure induction motors; (2) series motors; (3) repulsion motors; and in addition there have been designed various combinations of these classes. Pure single-phase induction motors have been very largely used for many classes of industrial work, but these are inefficient as compared with three-phase motors, and their starting performance is extremely poor. Curve I (fig. 1) shows the torque of a single-phase induction motor plotted against the speed. It is obvious from this curve that economical running is only obtained over a very small portion of the total speed range.

One of the most noteworthy types of these motors is that covered by Heyland's patent. The stator consists of a laminated iron core which is built up inside a cast-iron case. The rotor is built up of a slotted and laminated core carrying three sets of coils arranged as a drum winding, star connected, the three free ends being taken through the hollow shaft, and connected to three overhung phosphor-bronze slip-rings. The stator is provided with two windings, a starting and a running winding, the starting winding having a relatively high inductance that chokes back the current, and thus splits the phase sufficiently to provide a rotating magnetic field for starting purposes. A three-way rheostat serves to cut resistance out of the rotor windings as the motor speeds up, and in this way full load torque at starting is obtained with twice the full load running current.

Recently the alternating-current series motor has been attracting a great deal of attention, and is now on the market. Messrs. Ganz & Co. have been making this in small sizes for some time past, but it is only quite lately that commutation difficulties have been sufficiently overcome

to make it a practical success in large sizes. On account of its variable speed, however, it is not well adapted for most stationary work, and its sphere of usefulness will probably be confined to railways and cranes, where the direct current series motor at present holds the field. One advantage of the motor, of course, is that it will operate on either direct or alternating current, and it is found experimentally that it has practically the same characteristic when running on either system of supply.

The various modifications of the repulsion motor are, at present, attracting a great deal of attention, for it is this type that seems most nearly to approach the results that are obtained with direct-current shunt motors, *i.e.*, it has an excellent starting torque and a constant normal speed. The pure repulsion motor is practically useless owing to its poor running performance, but by connecting it as an induction motor when it is running up to speed, excellent results have been obtained. Fig. 2 shows one of the Lahmeyer Co.'s

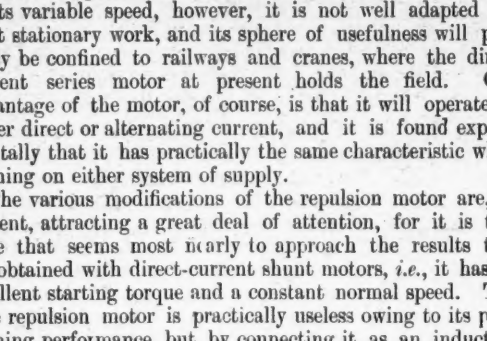


Fig. 2.

repulsion induction motors covered by the Schüler patent. These motors have a high torque during the whole starting period, and this torque can be regulated gradually so that there is no jerking. The stator is built up of laminated iron sheets insulated by paper, and as the outside current flows only through the stationary part of the motor, the latter can be built for comparatively high pressures. The rotor has an ordinary drum winding connected to a commutator on the one side and slip rings on the other. An ordinary three-phase rheostat is connected in the slip-ring circuit, and this switch is in the "off" position at starting. The brushes on

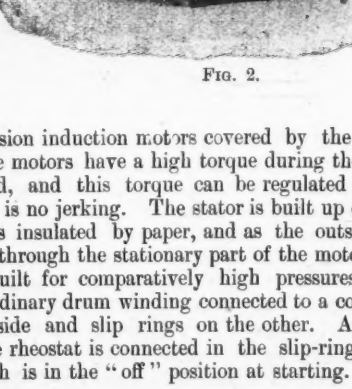


Fig. 4.

the commutator are short-circuited through a variable resistance, and thus the motor starts as a pure repulsion motor; with increasing speed, the rotor, which is connected to the slip rings, is gradually short-circuited, and the load is picked up on the induction side until, when full speed is reached, the motor runs at constant speed as an induction motor. The direction of rotation depends upon the relative position of the field to the brushes on the commutator, and in these motors reversal is obtained with the aid of two auxiliary windings in the stator which shift the direction of the magnetic flux through about 30°. The three curves in fig. 1 illustrate very well the performance of this motor. Curve II shows the torque with increasing speed due to the repulsion action, and Curve I represents the induction torque. Curve III shows the resultant obtained by combining these two.

Fig. 3 is a motor depending on very much the same principle, which has been placed on the market by Messrs. Crompton & Co. The rotor winding is connected to a number of slip-rings, and series of insulated copper bars traverse these rings at right angles. The carbon brushes are staggered in such a way that two or more of these cross-bars are always in circuit. The action is as

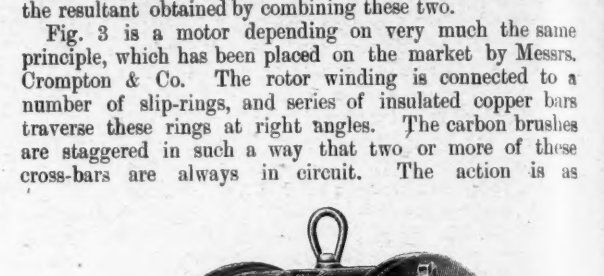


Fig. 3.

though a commutator had been pushed into a set of slip rings, and the repulsion torque obtained at starting is gradually converted into an induction torque as the motor speeds up. These machines are eminently suitable for lift and similar service, reversal being obtained by shifting the brushes through a small angle.

An interesting motor of the repulsion-induction type that has been placed on the market by Messrs. Marples, Leach & Co. is shown in fig. 4. The only device necessary to start this motor is an ordinary double-pole knife switch, no auxiliary condensers, compensating transformers or phase coils being necessary. The armature is provided with a commutator, and when running up to speed the induced current is short-circuited through carbon brushes so situated with regard to the field as to control the direction of rotation and the amount of starting torque. On reaching

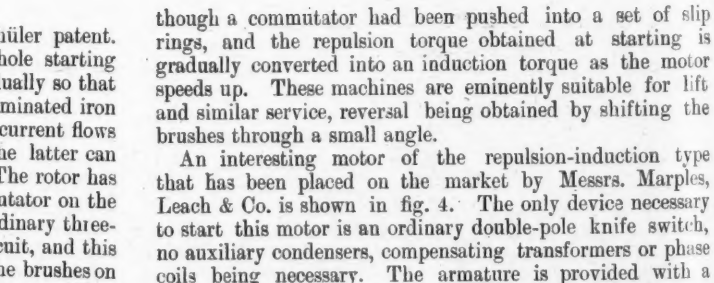


Fig. 5.

full speed, governor weights situated inside the commutator are thrown out by centrifugal force, and every commutator bar is short-circuited to one common ring of high conductance; at the same time, the pressure on the carbon brushes is released, the latter being pushed back from the commutator, and allowing the motor to run purely as an induction machine. This device is simple in construction, and is entirely protected, the weights alone being outside and at the end of the armature, as shown in fig. 5. The governor is entirely automatic, and when the motor is stopped, the device returns to its starting position.

These motors can be started from a distance by simply closing either the primary or secondary circuit, and they are thus specially adapted for pumping work, air-compressors or similar machines, arranged to be started and stopped by means of a float-switch or pressure regulator. When connected directly across the lines, a motor of this type will develop $2\frac{1}{2}$ times full load torque at starting with $2\frac{1}{2}$ times full load current, but by the time the motor has reached quarter speed, the torque will have increased to five times full-load torque, and the current decreased to double-load current. Both torque and current may be materially reduced by altering the relative position of the brushes and the field.

The Latour and Eichberg-Winter motors are really combinations of the repulsion and series types. These give excellent running performances, and it is probable that they will find a sphere of great utility in traction work. The Fynn single-phase motors have been fully dealt with recently in the Electrical Review, and therefore need not be described.

OUTSIDE DIFFICULTIES.

By an Overcomer.

Instructions were received by the firm in whose employ I was, to send an engineer to supervise the erection and starting up of an alternator we were supplying, and at the same time to see generally to the installation. The machine was to replace an existing machine, and was for the public as well as private lighting of a town in Galicia, Spain.

On my arrival I found the following state of affairs; the current was supplied at 1,000 volts by a single-phase alternator, which was to be replaced; insulated cables were taken overhead from the station to various points in the town, and the current transformed down to 100 volts for lighting. The transformers in all cases were fixed outside, one being fixed on the branch of a large tree, the rest on wall brackets: these latter transformers were not in the most suitable positions as regards the distribution, owing, no doubt, to there having been a difficulty when installing, in finding a stone wall or building, the majority of the walls and buildings being built of laths and mud. The transformers were all of the mantle type without any external cases, and the method adopted for protection against the weather was extremely simple: the lid of the transformer packing case was laid on the brackets, and the transformer was hoisted up on to the lid and connected up, the transformer case being then inverted and placed over the transformer, slots having previously been sawn out for the leads.

The high and low pressure cables were fixed in a large number of instances on the same insulators, the same binding wire being used for both conductors; in one or two instances the high pressure conductors were cleated direct on to the mud houses.

The existing alternator had been found too small to cope with the load, and in view of the larger machine being put down, the proprietors of the company were having new customers connected up as fast as their premises were wired, so that matters were getting worse day by day.

Whilst the foundations were being prepared for the new machine, the worst faults in the street mains were rectified (it being impossible to rectify all without putting down a new installation) and the transformers fixed inside buildings, the in and out-going cables as well as the transformers being suitably protected.

Before the machine foundations were completed it was discovered by the proprietors that they had forgotten to order the driving pulley for the new alternator. As the shortest delivery for this pulley would be three weeks, which might easily be prolonged to six, it was decided temporarily to make use of the existing pulley, which was about 2 ft. 6 in. too small in diameter. Carpenters were immediately set to work preparing materials, and on shutting down one morning at seven o'clock, a number of wooden blocks were fixed by means of straps at short and equal distances round the face of the pulley. To these blocks uprights were fixed, and short pieces of boards were nailed to the latter, the joints being in all instances arranged so that they were on the uprights so as to keep firm, and then planed to take off the sharp corners.

The whole of the work was completed shortly after midday, the new machine, which had in the meantime been fixed and connected up, taking the load the same evening. As there was no day load, the work was therefore carried out without any interruption to the supply.

JOHANNESBURG MUNICIPAL ELECTRICITY SUPPLY.

Through the courtesy of Mr. J. F. T. Thomas, general manager of the electricity supply department, we have received a small pamphlet setting forth the conditions under which the Council is prepared to supply electrical energy; the pamphlet, which is sold for 1s., is dated June 1st, 1906, but the conditions were adopted by the Council on May 9th, 1905.

The Johannesburg municipal supply comprises two distinct systems. The "inner" area is supplied with continuous current at 230 volts for lighting and motors up to 3 H.P., and at 460 volts for larger motors, which is maintained continuously. The "outer" area is supplied with single-phase current of 50 cycles at 200 volts for lighting and motors up to 1 H.P., and at 400 volts for larger motors, which is maintained from half-an-hour before sunset to half-an-hour after sunrise.

The conditions do not generally differ very much from their prototypes in this country, but the following points may be of interest:—

Notice of Installation or Extension.—It is laid down that written notice must be given of intention; this is rather unusual, but whilst no mention is made of what would follow if such notice were not given, the requirement is a useful one in many ways. With regard to completion, it is held that the manager may test the installation . . . . *if he thinks necessary.* It would be interesting to learn when and why exceptions are made.

Fire Insurance.—A clause states that *it is advisable* that all work on consumer's premises should be carried out in accordance with the rules of the fire insurance company with which the premises are insured. We shall revert to this later on.

Works Carried Out by the Electric Supply Department.—If the service cable is over 60 ft. long, the extra length is charged for.

Meters.—Small motors connected across one side of the three-wire system are put on the lighting meter, unless 2s. 6d. per month is paid for an additional meter. Surely 30s. per annum is a lot to pay in meter rent to obtain the benefit of the power rate for a small motor!

Provision to be Made by the Consumer.—A diagram of connections is given, showing exactly how the consumers' switch and fuses have to be arranged in relation to the service mains and apparatus.

Distribution Board.—It is specified that each board shall be arranged, so that it stands out fully 2 in. from the wall, so that all connections behind it can easily be traced. All circuits should be properly labelled and opposite poles of every circuit connected in line with one another to prevent confusion.

Arrangement of Circuits.—Installations of more than 100 lamps, or exceeding 25 amperes with all lamps burning, must be divided into two distinct circuits controlled by separate main switches.

Testing.—After receipt of notice to test at least four days before the test is required, one test will be made free of charge. If the work is not ready, or it fails to pass the test, a fee of 20s. must be paid before another test can be made.

The test is made with a pressure of 500 volts between conductors and earth, and must show:—

For 12 lamps	... ...	5 megohms
„ 25 „	... ...	2·5 „
„ 50 „	... ...	1·5 „
„ 75 „	... ...	1·25 „
„ 100 „	... ...	1·00 „
„ 150 „	... ...	0·75 „
„ 200 „	... ...	0·50 „
„ 250 „	... ...	0·30 „
„ 300 „	... ...	0·20 „

and no installation will be connected in which the insulation between conductors and earth is below 75,000 ohms.

It is made clear that the contractor is in no way relieved of responsibility by the Council's test, and that the act of connecting up is no guarantee of good work.

Leakage.—The supply will be cut off if a leakage is discovered of more than one 10-thousandth part of the maximum supply current to the premises.

Motors.—Starting switches and resistances must be supplied for motors having a starting current of over 5 amperes, and the steps must not exceed 5 amperes.

It is laid down that motors of over 3-H.P. must comply with the following requirements:—

(*a*) All conductors used must be run in metal pipes made electrically continuous throughout, and earthed as described below.

(*b*) All metal work connected with the motor, starting switch, and resistance which does not carry current must be efficiently earthed, and in no case must the earth connection used for this purpose be made by a copper conductor smaller in size than 3/18's S.W.G. The earth connection must not be made to a gas pipe.

(*c*) All parts of the motor, switches, and resistances carrying current shall be efficiently guarded, so as to prevent accidental contact being made with them or a short circuit being caused. All such guards should be of metal, and properly connected to earth as mentioned above.

(*d*) The brush rocker on the motor must be so arranged that it cannot be moved in such a way as to bring either conductor into contact with the framework of the motor.

(*e*) The Council will decline to give a supply to any motors which do not comply with the requirements of this clause.

(*f*) Motors should be protected from damp and dust, and should be so placed that no woodwork or inflammable material is within a distance of 12 in. from them, measured horizontally, or within 4 ft. from them measured vertically above them, and the same precautions must be adopted in placing and fixing the starting switches and resistances used in connection with them.

(*g*) The coils of starting resistances should be so designed that in no case do they heat above 212° F., even if left continuously in use, and the coils should be insulated with porcelain or other non-combustible insulating material, and should be protected by suitable metal casing or guards, which must not interfere with free circulation of the air round the coils.

(*h*) Where a motor is intended to be used in the presence of explosive dust or gas, the motor should be of the completely enclosed type, or if of the ordinary type it should be completely enclosed in metallic casing, and arrangements should be made for efficient ventilation of such casing by means of air drawn from outside the building.

With regard to paragraph (*g*), it seems to us that the limitation of 212° F. for the coils of starting resistances is hardly fair. There are excellent apparatus of this make which can be used at a much higher temperature quite safely owing to their ironclad construction, and the limitation above-mentioned must tend to raise the price unnecessarily.

Arc Lamps.—Starting resistances must be used when the starting current exceeds the normal current by more than 80 per cent.

Wiring Rules.—A short list of rules are given by the Council for the guidance of consumers and contractors. It is stated that the rules are based on the standard rules of the I.E.E. and represent the best practice, and that consumers will find it to their advantage to insist upon contractors working to these rules. We have no exception whatever to take to this excellent advice, but would point out that it does not conform to that given under "fire insurance," because it is well known that the Fire Office rules fail to agree in many important respects with the I.E.E. rules. Consequently, the consumer is likely to become confused.

Conductors.—The 1,000 ampere-per-square-inch rule is given, but the I.E.E. conductors are based on quite a different rule.

Casing and Tubing.—Wood casing is permitted for surface work only. Concealed conductors must be run in suitable piping, which must be made electrically continuous and efficiently earthed, and should be run so that all moisture condensing therein can drain away. Open joint Simplex tubing must not be buried in concrete.

Open Wiring.—Insulated conductors carried on porcelain cleats may be used if kept clear of the wall and in view; also in roofs, if a trap door is provided to allow for inspection.

Finally, there is nothing in these conditions and rules to countenance the old idea that wiring could be carried on in Johannesburg by the slap-dash methods once in vogue in this country. In spite of the dry and rarefied atmosphere there, the rules, as a whole, would be quite suitable for any supply in this country.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

16,549. "Device for testing high tension sparks as used for ignition purposes in internal combustion engines." W. F. Kelly. July 23rd.

16,568. "Improvements in or relating to electric arc lamps." Jandus Arc Lamp and Electric Co., Ltd., and A. D. Jones. July 23rd.

16,582. "Improvements in or relating to fittings for electric lamps." A. J. Boult. (R. J. F. S. Baron, France.) July 23rd.

16,584. "Improvements in and relating to fuse or electric cut-out." C. A. Steller, jun., and J. Waldron. July 23rd. (Complete.)

16,590. "Improvements in and relating to railway train electric lighting apparatus." R. H. Martin. July 23rd.

16,597. "Improvements in systems of control for electric motors." N. W. Storer and W. Cooper. (Date applied for under Patents Act, 1901, July 24th, 1905, being date of application in United States.) July 23rd. (Complete.)

16,601. "Improvements in and relating to electric switches." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) July 23rd.

16,602. "Improvements in and relating to electric switches." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) July 23rd.

16,627. "Harmonic ringing machine for telephone exchange systems." W. H. Wheatley. (The firm of C. Lorenz, Germany.) July 23rd. (Complete.)

16,646. "Combined automatic electric clock switch." F. T. Reid. July 24th.

16,668. "Improvements in electric arc lamps." F. Proctor. July 24th.

16,690. "Improvements in electric apparatus for the ignition of mines." R. O. Berglund, W. A. W. E. Hjorth and C. E. Ljungman. July 24th. (Complete.)

16,693. "An improved automatic electrical signalling apparatus for use on railways." S. Ciri. July 24th. (Complete.)

16,696. "Improvements in systems of wireless telegraphy applicable to railway trains and the like." W. P. Thompson. (Gesellschaft für drahtlöse Telegraphie, m.b.H., Germany.) July 24th. (Complete.)

16,711. "Improvements in section insulators for overhead conductors for electric railways and tramways." P. Dawson. July 24th. (Complete.)

16,712. "Improvements in double catenary suspenders for overhead conductors of electric railways and tramways." P. Dawson. July 24th. (Complete.)

16,713. "Improved clip for connecting the trolley wires of electrical railways and tramways to catenary suspension wires." P. Dawson. July 24th. (Complete.)

16,729. "Improvements in dynamo-electrical machines." E. C. Ketchum. July 24th. (Complete.)

16,745. "Improvements in or relating to apparatus for producing electric waves or impulses in an electric telegraph system." A. T. M. Johnson and Johnson Secret Wireless Telegraph and Telephone Testing Syndicate, Ltd. July 24th.

16,746. "Improvements in or relating to apparatus for use in electric telegraph systems." A. T. M. Johnson and Johnson Secret Wireless Telegraph and Telephone Testing Syndicate, Ltd. July 24th.

16,747. "Improvements in or relating to receiving apparatus for use in wireless telegraph systems." A. G. Hellyar and Johnson Secret Wireless Telegraph and Telephone Testing Syndicate, Ltd. July 24th.

16,760. "Improvements in means for electrically lighting and extinguishing gas burners." K. Abel. July 25th. (Complete.)

16,785. "Improvements in electric smelting furnaces." W. Moseley. July 25th.

16,791. "New electrically-driven apparatus for removing dust or dirt from carpets, furniture and for like domestic purposes." M. W. Allenby. July 25th.

16,814. "Improvements in connection with current collectors for vehicles or mains, running on electric railways or tramways, with overhead conductors." P. Dawson. July 25th. (Complete.)

16,818. "Improvements in and relating to alternating-current electric meters of the induction type." Allgemeine Elektrizitats Ges. (Date applied for under Patents Act, 1901, July 25th, 1905, being date of application in Germany.) July 25th. (Complete.)

16,819. "Improvements relating to electric starting switches and regulators." E. P. Allam. July 25th.

16,820. "Improvements relating to direct-current electric supply systems." J. S. Highfield. July 25th.

16,837. "Improvements in and relating to pulleys for the trolley of electric railways, tramways and other purposes." A. Welsh. July 26th. (Complete.)

16,870. "Improvements in or relating to anodes for electrolytic purposes." F. Greenfield. July 26th.

16,895. "Improvements in and relating to electric transformers." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) July 26th.

16,897. "Improvements in and relating to illuminating electrically letters, advertisements and the like." L. T. Young. July 26th.

16,905. "Improved thermo-chemical generator of electricity." P. L. Basset. (Date applied for under Patents Act, 1901, July 27th, 1905, being date of application in France.) July 26th. (Complete.)

16,941. "Improvements in electrical contact-breakers of explosion engines, particularly for motor vehicles." W. J. Charles and A. Watson. July 27th.

16,957. "Improvements in apparatus for use in starting and controlling electric motors." A. Taylor, T. Eaton and H. Schwarz. July 27th.

16,971. "New or improved apparatus or device for electrically indicating at a distance whether billiard tables or the like are engaged or disengaged; also applicable for other signalling, indicating or advertising purposes." A. D. Rayner and L. Fraser. July 27th.

17,018. "Improvements in prepayment electricity meters." H. Aron. July 27th. (Complete.)

17,071. "Improved signalling apparatus for electric railways." A. Parusel. July 28th.

17,077. "Improvements relating to arc lamps." R. P. Myers. July 28th.

17,079. "Improvements in magnetic motors or generators." H. Hitching. July 28th.

17,086. "Improvements in or relating to telephonic transmitters. E. A. Graham. July 28th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

Electrical Timing Apparatus for Timing Motor-Cars and for other Analogous Purposes. J. M. Inglis. 12,973. June 23rd.

Electrical Steering of Ships. B. P. Haigh. 13,856. July 5th.

Surface Contact Electric Traction Systems. E. A. Mitchell and Dolter Electric Traction, Ltd. 14,297. July 11th.

Manufacture of Electrical Resistances. C. Ruzicka. 14,400. July 12th.

Alternate Current Induction Motors. L. J. Hunt and the Sandycroft Foundry Co. 14,401. July 12th.

Controllers for Electrically Propelled Vehicles. J. S. Raworth. 14,630. July 15th.

Polarised Electro-Magnets. W. Drury. 17,531. August 30th.

Electric Signal Indicator for Railway Engines. A. J. Hayter. 17,772. September 2nd.

Filaments for Electric Incandescent Lamps. British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) 19,264. September 23rd.

Process for the Electrolytic Manufacture of Metal Tubes and other Bodies. W. Clark. (F. Darmstadter, Germany.) 24,734. November 29th.

1906.

Single-Phase Alternate Current Commutator Motors. V. A. Fynn. 238. January 3rd. (Date applied for under International Convention, April 15th, 1905.)

Electric Switches. C. E. Hunter. 3,000. February 7th.

Electro-Magnets. F. W. Howorth. (J. W. Holman.) 5,371. March 5th.

Luminous Electric Bell Indicators and Contact Makers for Use Therewith. C. Milde, A. Courtant, E. Minvielle and C. Milde, junr. 6,216. March 14th. (Date applied for under International Convention, March 14th, 1905.)

Process for Obtaining Electrolytic Metallic Deposits. L. Trunkhahn 11,498. May 16th.